THE GLASS INDUSTRY

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GAYNER GLASS WORKS . . . an off hand-mechanized plant

Although modern forming machines figure largely in this concern's operations, after 70 years hand blowing is still of primary importance.

By C. B. DELGADO

Glass manufacture, because it was one of the earliest industries in America, has had many examples of family ownership and operation through three and four generations; and outstanding among these concerns is the Gayner Glass Works of Salem, New Jersey, which observes its seventieth anniversary this year. There are, perhaps, many concerns in varied industries which can date their origin back seventy years or more, but not many companies will be found that are still under the direction and operation of the founding family after this lapse of time.

Gayner Glass Works is unique not only because it is one of the oldest concerns in the industry still under its original corporate management, but because today it utilizes the most modern glass making equipment for container manufacture; and under the same roof produces by hand such items as carboys, battery jars and other specialties—all of vital importance in the war effort. A brief description of some of the plant's operations will follow, but first an outline of the founding and development of this distinguished company should be presented.

Although the Gayner Glass Works was not established until 1874, its founder, John Gayner, really entered the glass business about one hundred and five years ago when he went to work for his father, Edward Gayner, in Bristol, England, at the age of twelve.

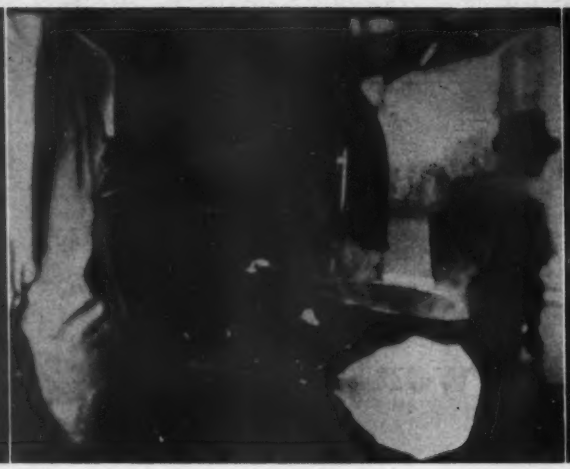
John, the founder, worked in the plant where his father was manager until 1865 and then entered into business for himself. There is not much known of this enterprise, however, as a year later he came to the United States, arriving in Portland, Maine.

Between the time of his arrival in America and the establishment of the first Gayner plant, John Gayner worked in a number of glass factories; in Boston; Bergen Point, New Jersey; Wheeling, West Virginia, and Norristown, Pennsylvania. However, in 1874 a partnership with Maurice Rawleigh was formed and the Gayner and Rawleigh plant went into operation in Waterford, New Jersey.

In 1877 Rawleigh withdrew from the business and a new partnership was established and known as Gayner and McDevitte. The firm continued through several changes from 1878 until 1898 when Gayner Glass Works became an incorporated company. The partnership with McDevitte was dissolved in 1878 and a new one set up with S. J. Pardessus. Gayner and Pardessus moved to Salem in 1879, but in 1884 the plant was destroyed by

Gayner Glass Works About 1879.

Gathering glass.



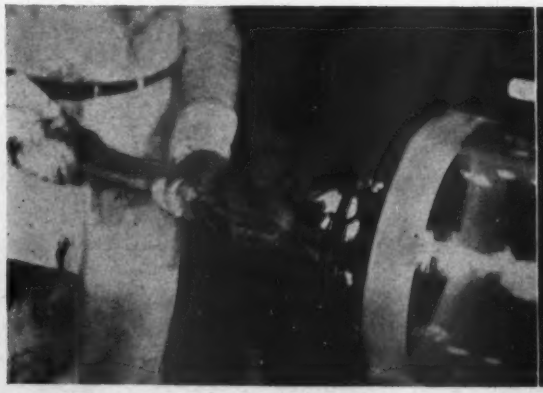
Three gathers of glass are made. This is the final gather preparatory to blowing.

Blocking a carboy. Gob p
tially blown prior to reheat
in glory hole. Gobs are bla

Blowing parison which rests on steel pad before placing in mould.

A carboy parison going into the mould.

A carboy co



Making corkage on a 13-gallon carboy.

Carboy being placed in specially designe
Hartford-Empire lehr. Lehr tunnel is co
siderably higher than standard equipment t
permit passage of carboys.

three times be-
e parison is
med.

Final gather being smoothed in cast iron block containing small amount of water. Next step is actual blowing.

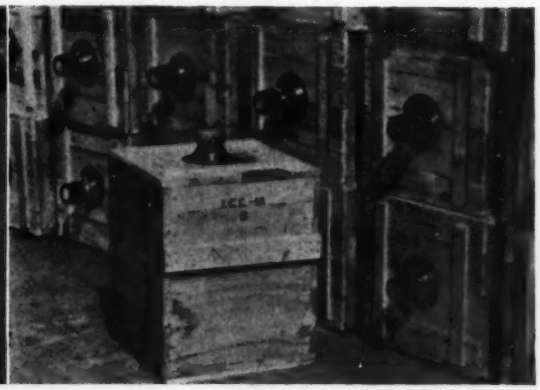
Re[illegible]ting after blocking before entering mould.

of the mould.

Carboy held in "snap." Applying wet file at the neck of carboy to break off from blow pipe.

Reheating the neck before making corkage.

carboy packed according to ICC specifica-
ions before lid is placed on box. Cork is
sed for cushions.



Packaged carboys ready for shipment.

John Gayner, Founder of the Gayner Glass Works

E. J. Gayner, the late President

J. M. Gayner, President Since 1937

fire. A new factory was soon built on the site of the present glass works.

This plant operated under the Gayner-Pardessus partnership until 1885 when the latter withdrew. The business was then conducted personally by John Gayner until its incorporation, as already stated, in 1898.

John Gayner remained active up to the time of his death at the age of ninety-four in 1925. His son, E. J. Gayner, took over the reins upon his father's death and administered the business until he passed on at the age of eight-one in 1937. Following in his father's footsteps, John M. Gayner, who now heads the company, became president in the same year.

A brother, Joseph F. Gayner, is first vice president of the company and a fourth generation of Gayners, Lewis F. Gayner, son of President John M. Gayner, holds the position of secretary and assistant treasurer. At the present time Lewis F. is on leave of absence in Washington where he heads the Glass Container and Closure Section of the War Production Board.

Glass manufacture has come a long way since the first melt in the Gayner plant in Salem, but despite the great advances in materials, equipment and glass technology, for certain types of ware hand blowing and pressing are still the order of the day and a very large part of Gayner's production falls into this category. However, it is not to be inferred that this South Jersey factory is a hand plant. Not far from the spot where as much as twenty-six pounds of glass is gathered on a punty for a thirteen-gallon carboy one can see modern Hartford I. S. Machines turning out bottles or jars at speeds we have all become accustomed to expect.

Battery jars are another specialty of Gayner Glass Works and today are of utmost importance as vital equipment in many war activities.

In the production of carboys not only the highest glass-blowers' skill is required but a goodly amount of physical stamina is essential. Twelve pounds of glass for a five-gallon carboy and twenty-six pounds for the thirteen-gallon size needs some "huffing" as well as puffing. And the specifications for carboys are rigid.

Furnace facilities in the Gayner plant are comprised of three continuous tanks. One of these tanks serves the I.S. machines, the other two supply glass to the hand shops. The fact that two continuous furnaces are kept in operation to furnish glass for hand production suggests the enormous volume of carboys, battery jars, etc., which are being produced in Salem.

Although continuous tanks of modern construction are used for melting, after the carboys are blown the annealing operation reverts to the old method of tempering in bricked-up ovens. Not all carboy production is annealed in this manner but under today's demands all facilities must be utilized.

The annealing of carboys in ovens takes about thirty-six hours. After this lapse of time the temporary brick work is torn out, samples are removed and tested under suitable polariscope equipment. When annealing of carboys is done in lehrs a five-gallon container will go through in three hours; the thirteen-gallon size requires five to six hours.

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The present Gayner Glass Works, occupying eleven acres. Since this aerial view was taken several buildings have been added.

DETERMINATION OF THE PRECISION OF ANALYTICAL CONTROL METHODS

Editor's Note: This condensation of an article written by R. F. Moran which appeared in the June, 1943, issue of *Industrial and Engineering Chemistry*, Analytical Edition, should be of interest to those responsible for the interpretation of such laboratory and engineering data that is obtained for the control of plant operations and product quality. The procedures outlined illustrate rather well the usefulness of statistical methods as an auxiliary tool in industry and also indicate the trends being followed by industries outside of the glass field.

In the belief that this particular statistical treatment could well be used on glass plant data such as routine chemical analyses, routine glass density measurements, routine softening point determinations and the like, the following condensation of the original paper has been submitted to *The Glass Industry* for publication.

It is a primary concept of nature that no one physical measurement is exact. The determination of the composition of any sample even by the best known technique is similarly influenced by the inability to measure weights, volumes, colors, chemical equilibria, etc., with exactitude. When the conditions that obtain in commercial control laboratories are considered, this concept becomes more important. Since these variations are known to exist, they are a constant threat to good commercial operation or product quality until they are quantitatively determined. In addition, there also exists a tendency on the part of many engineers, sales personnel, and even chemists to treat a single analytical result as an exact quantity and to make decisions therefrom that would be unjustifiable if the significance of the result were known. Statistical treatment of such data by the following procedures will give a quantitative measure of their precision.

Limit of Uncertainty Under the Best Conditions (LU_1).

The highest precision that can be expected from an analytical method is the precision as shown by the best available technician working under the most closely controlled conditions. The following procedure was prescribed as standard for obtaining a measure of this precision. Prepare a synthetic mixture that exactly reproduces the commercial material and contains a known amount of the desired ingredient, or select a representative homogeneous sample of the commercial material. Store enough material for at least fifty analyses in containers that will prevent any change in composition for at least one year. Select an analyst who is well acquainted with the method, preferably the one who developed the method. Prepare fresh reagents, standardize all solutions, and calibrate all apparatus before making the determinations. Run ten analyses as closely together as possible under the most favorable conditions. Calculate all results to one more place than is generally reported. Calculate the arithmetical average $\overline{X}_1$ of the ten analyses. Calculate the standard deviation of the results by using the equation:

$$\sigma_{10} = \sqrt{\frac{\Sigma \delta^2}{10}}$$

Where σ_{10} is the standard deviation from the average shown by the ten results and is the individual deviation of each result from the average, calculate the limit of undertainty of the average, LU_{av}, by the following equation:

$$LU_{av} = \overline{X}_1 \pm \frac{3\,\sigma_{10}}{\sqrt{10}}$$

Table I indicates the method used for calculation.

TABLE I

Precision of Method under Best Conditions

Test No.	Specific Gravity at 25°/4° C.	d	$d^2(\times 10^{10})$
1	1.5849	− 0.00016	256
2	1.5851	+ 0.00004	16
3	1.5853	+ 0.00024	576
4	1.5853	+ 0.00024	576
5	1.5850	− 0.00006	36
6	1.5849	− 0.00016	256
7	1.5847	− 0.00036	1296
8	1.5851	+ 0.00004	16
9	1.5852	+ 0.00014	196
10	1.5851	+ 0.00004	16

Av. $= \overline{X}_1 = 1.58506$ $\qquad \Sigma d^2 = 3240 \times 10^{10}$

$$\sqrt{\frac{\Sigma d^2}{10}} = 0.00018 = \sigma_{10}$$

$$\text{LU av.} = 1.58506 \pm \frac{3(0.00018)}{\sqrt{10}} = 1.58489 \text{ to } 1.58523$$

$$LU_1 = \frac{3(0.00018)}{0.923} = \pm 0.00059$$

Limit of Uncertainty Under Routine Conditions (LU_2).

If all the above conditions have been satisfied, the method may be tested under routine conditions as follows: Use the sample on which the LU_1 test was made. Have the sample analysed in a routine manner by a routine technician, preferably together with routine plant samples of a similar nature. If possible, the technician should not know the prior results. Have the sample analyzed in duplicate each month for one year, using as many different routine technicians as possible. As soon as the monthly analyses have been completed, compare the results with the average and LU_1 obtained during the first test. If the individual results are within $\overline{X}_1 + LU_1$ allow them to stand as representative. If the results are outside these limits, immediately check the technique, reagents, etc., so that any deviation from the

(*Continued on page* 178)

A. C. S. PROGRAM OF PAPERS AND EVENTS

Following a number of group meetings during the day, the 46th Annual Meeting of the American Ceramic Society will be formally opened Sunday evening, April 2nd, with an address by President Cecil Eugene Bales.

Immediately following the president's talk, Hoyt C. Hottel, Department of Fuel Engineering, Massachusetts Institute of Technology, will deliver the Edward Orton, Jr. Fellow Lecture, "Infraray Heating".

As in the case of the Meeting of a year ago war problems hold a prominent place on the general program and Secretary Purdy has again arranged a War Conference General Session. All of Monday the 3rd will be devoted to this meeting—the conference being divided into morning and afternoon sessions. The following papers and speakers are listed for the War Conference:

Morning Session

1. Be Vigilant
By Major Albert J. Stowe: Military Intelligence, Office of Civilian Defense, Washington, D. C.

2. Wage Incentives
By James Finney Lincoln: Lincoln Electric Company, Cleveland, Ohio.

3. Postwar Housing Relationship to Industry
By I. W. Clark: Westinghouse Better Homes Department, Pittsburgh, Pa.

4. Porcelain Enamel in Postwar Enamel Industry
By Robert A. Weaver: Ferro Enamel Corporation, Cleveland, Ohio.

Afternoon Session

5. Ceramic Problems and Application of Wage Incentive Methods Thereto
By Edward F. Borden: Douglas T. Sterling Company, Stamford, Conn.

6. Industry Prepares for Peace
By John A. Stephens: United States Steel Corporation of Delaware, Pittsburgh, Pa. (Chairman, Allegheny County of Committee for Economic Development).

7. Industrial Design and Creative Postwar Thinking in Glass, Clay, and Enamel Industries
By J. Gordon Lippincott: Dohner and Lippincott, New York, N. Y.

8. Chemistry in Defense and Recovery
By Edward R. Weidlein: Mellon Institute of Industrial Research, Pittsburgh, Pa.

The Glass Division Luncheon and Business Meeting will be held Tuesday noon in the Cardinal Room, starting time—12:30 P.M. A meeting of Sub-committees of Committee C-14, A.S.T.M. is scheduled for the same day at 4:00 P.M.

On Wednesday morning a meeting of Committee C-14, A.S.T.M., on Glass and Glass Products will be held under the chairmanship of Dr. J. C. Hostetter.

The General Luncheon is set for Wednesday noon in the Ball Room and an interesting feature of this luncheon will be a talk by Douglas C. Carson, Director of the Antique Department of Steuben Glass, Inc. The subject of his address will be "Eighteenth Century English and Irish Glass."

William Penn Hotel, Headquarters for the 46th Annual Meeting.

Sometime during the three days which will be devoted to the various meetings, a supplementary talk will be delivered by Dr. Frank Jones concerning the founding of the new research institute Glass Science, Inc. It may be mentioned here that an outline of this new society appeared in the March issue of THE GLASS INDUSTRY. No definite time has been stated for this address but indications are that it will probably be given sometime Wednesday the 5th.

As far as the Glass Division Program is concerned it seems K. C. Lyon, the Program Chairman has developed a program which should attract the attention of all glassmen. While there are a number of highly technical papers listed, others have been developed which will be of direct interest to the plant executive. For example, there is a Hand Plant Session and a Symposium on Glass Furnace Operation, and in connection with the latter meeting a round table discussion is planned with Messrs. A. W. Dodge, Hazel-Atlas Glass Company, W. W. Oakley of Corning Glass Works and J. A. Wright of Owens-Illinois leading the discussion.

Another interesting feature of the Program is the Symposium on Optical Glass. Papers by leading technologists will be presented. Unfortunately, due to the curtailed convention period, this Symposium must be held concurrently with that on Glass Furnace Operation. However, for those having a primary interest in this field of glass technology attendance at the meeting should prove decidedly worthwhile.

Despite limitations imposed by war conditions, a program of diversion has been worked out by the Entertainment Committee. Chairman of the Committee is Harold E. Simpson, Mellon Institute. Others serving on

the Committee are: Mr. and Mrs. Francis C. Flint; Mr. and Mrs. N. S. Garbisch; Mr. and Mrs. Ernest Hommel; Mr. and Mrs. W. Keith McAfee, and Mr. and Mrs. A. A. Wells.

The Ladies Entertainment Committee has arranged a tea for Monday afternoon in the Ladies Headquarters Parlors, and for Tuesday afternoon a Bridge Luncheon is scheduled at the Twentieth Century Club.

Monday, 7:30 P. M., is the time set for the Informal Dinner and Entertainment which will be held in the Ball Room. Alumni Dinners will take place Tuesday evening but specific dining rooms have not been announced as this issue goes to press. Also scheduled for Tuesday evening is the Camera Club Dinner and, as in the case of the Alumni Dinners, its time schedule is 7:00 P. M. to 9:00 P. M., hence does not overlap the annual informal dance and floor show.

The Sixth Annual Exhibit of the Ceramic Camera Club will be held all week in Parlors E and F. Chairman and Secretary of the Club B. H. Remington has announced the following Jury of Selection: Ross Altwater, W. O. Breckon and O. E. Romig. The Committee of the Frazier Award of Merit is comprised of Walter A. Weldon and F. J. Von Tury. Announcement of prize winners will be made Tuesday evening during the club dinner.

The daily program together with brief summaries of papers to be presented to the Glass Division follow.

GLASS DIVISION PROGRAM

Tuesday A.M.

1. Glass in the Electronics Industry

By H. C. Steiner: Tube Division, General Electric Company, Schenectady, N. Y.

Electronic tube design is concerned with properties of glass which are of little importance in other fields. In particular, the glass must be of such composition that it may be sealed to metallic leads and parts. The seal must be vacuum-tight. The expansion of the glass and metal must be closely matched or, with dissimilar characteristics, the design must limit the glass stresses to safe values. The glass must also have sufficient resistance at the operating temperature to prevent electrolysis. Some of these special characteristics are reviewed, and the current use of glass in the electronics industry is discussed.

2. Effect of Fluorine and Phosphorus Pentoxide on Certain Physical and Chemical Properties of Glass

By Owens-Illinois Research Laboratory: Owens-Illinois Glass Company, Toledo, Ohio.

The effect of the substitution of fluorine for silica on the viscosity, liquidus temperature, and chemical durability of a typical soda-lime glass is shown. The effects of substitution of P_2O_5 for (*a*) silica and (*b*) dibasic oxides in two typical soda-lime glasses are also shown.

3. Effects of Fluorides on Glass

By Paul M. Corbett: Pennsylvania Salt Manufacturing Company, Philadelphia, Pa.

4. Properties of Some Vycor-Brand Glasses

By M. E. Nordberg: Corning Glass Works, Corning, N. Y.

Physical and chemical properties are discussed for Vycor-brand glasses prepared from lower silica glasses by leaching processes. A brief resume of the process is given. Some porous properties of the intermediate leached glass are given. Also, mention is made of a multiform glass prepared by powdering a high silica glass, casting into the desired shape, and refiring.

5. Surface Tension and Persistence of Cords in Glass

By Mellen A. Knight: Preston Laboratories, Butler, Pa.

The action of surface tension in molten glasses is discussed in relation to cord persistence. An examination is made of the reported mechanism for the solution of cords as proposed by H. Jebsen-Marwedel. His viewpoint that the shape of immersed cords is governed by surface-tension differences between the cord and matrix glasses appears to be in conflict with the physics involved. The possible influences of interfacial tension on the shape of cords and on their location in or on the melt are considered along with its relation to other physical forces. The only stable form for cords under the influence of interfacial tensions alone is concluded to be a spherical one. Other factors, such as high viscosities, varying diffusion rates, and mechanical and thermal stirring, cause the irregular shapes found in practice. The relation of surface tensions to these factors requires further study.

Tuesday P.M.

Hand Plant Session

6. Glasshouse Stones

By W. L. Fabianic: Owens-Illinois Glass Company, Alton, Ill.

Most of the various types of glass stones actually found under operating conditions in soda-lime bottle glass furnaces are discussed. Each type is described in detail, and several photomicrographs of each kind of stone are shown. The possible source of each type of stone is considered as well as general methods for its identification and elimination. Auxiliary aids in helping the petrographer, such as the use of solvent acids and chemical analyses, are touched on. Stone specimens from flint, amber, and green glasses are described.

7. Cords

By L. G. Ghering: Preston Laboratories, Butler, Pa.

Cordy glass is troublesome in the manufacture of any line of glassware for several reasons, namely, (1) interference in the fabrication process, (2) inferior mechanical strength of the ware, and (3) appearance and other defects in the ware. Cords are composition variations in the melt, and all difficulties with them arise from this composition difference. The composition heterogeneity may arise from unmixed batch, poor mixing in the melt, or refractory contamination in the melt. There is no general rule for the diagnosis of their origin whether in tanks or pots.

8. Decolorizing Pot Glass

By S. R. Scholes: New York State College of Ceramics, Alfred, N. Y.

The principles of decolorizing are reviewed, and the influence of iron content of raw material, oxidizing or reducing agents in the batch, chemical and physical decolorizers, and possible substitution of other reagents for restricted chemicals is discussed.

9. Suggestions Concerning Pots in Hand Plants

By Axel Ottoson and C. J. Uhrmann: Imperial Glass Corporation, Bellaire, Ohio.

The importance of low porosity to get longer life and fewer cords and stones is discussed, and suggestions are presented for lowering porosity. Various methods of preheating are listed, and new pot materials and designs are described.

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THE FOREMAN'S PART IN BETTER LABOR RELATIONS

By O. C. COOL
Director, Labor Relations Institute, New York

A very wise employer told me the other day, "We have never encountered a single instance of labor trouble which could not have been prevented if we had had the right kind of foremen on the job. We see now that the way to prevent *future* situations is by selecting foremen who can lead as well as boss—and who can live up to the management and labor relations responsibilities which go with their title."

I agree with him a thousand percent. Show me *any* plant where the foremen really perform the functions which belong to their job—and perform them well—and I will show you a trouble-free factory. One reason it will be trouble-free is that uniform high-quality foremen don't "just happen"; having skilled, properly-trained, competent supervisors throughout the works is a desirable goal that can be attained only as a result of sound management policy. And when it comes to the selection of foremen, the average company just hasn't any policy. Instead of regarding foremanship as a specialized branch of management, the average firm appoints its foremen on wholly irrelevant grounds. "Tim Smith has been with the company for 23 years. Make him the foreman." Or, "Bill Jones has been the top producer in that department since the war began. He's the man to promote to foreman."

I call these factors irrelevant because being a faithful workman or a marvel of production efficiency has practically nothing to do with being a good foreman. Some of the best foremen in industry today never worked in a factory before Pearl Harbor, and not all of these possess more than average mechanical ability. What do they have that the hard-boiled foremen of the old school lack? For one thing, they have foremanship ability—and were chosen for that reason. For another, they have been trained to become foremen, and they regard their position as a special craft—almost a profession. They take pride in their four-fold relationship to the workers in their charge, serving them as (1) instructor; (2) director; (3) interpreter and (4) friend.

The successful foreman appreciates the true significance of *morale* as a production factor. In carrying out the major duties enumerated above, he treats the workers in his charge as human beings with rights and dignities and privileges—regarding himself as their leader rather than their boss. He would score at least 400 in Glenn Gardiner's famous test, in which 100 is given for an affirmative answer to each of the following questions: 1. Do you know and call each worker by his first name? 2. Do you know the marital status, number of children, years of schooling and at least one outside interest of each worker under you? 3. Do you *always* ascertain a worker's viewpoint before making a decision affecting his interests? 4. Do you *always* give full credit for the worker's ideas and suggestions? 5. Do you get more satisfaction from praising workers than from "bawling them out"?

To the old-type foreman these questions would smack of molly-coddling—on the tender side rather than the tough, and therefore just another silly notion of management. But one big company—Western Electric—made a test which actually proved that the *attitude of the foreman* is the basic fundamental of good working conditions. This firm took a group of employees and surrounded them with everything that could make their duties pleasurable—and discovered that pleasant physical surroundings, perfect lighting, fine toilet facilities, rest periods, snacks during work hours, etc., really increased output very little. But when the emphasis was shifted to *improving the nature of the supervision*—how the workers got along with the foreman, whether they were treated equally and praised for doing good work, production soared. In short, you can modernize a plant all you please, but it will do little good if the foremen still live in the Middle Ages.

There are other proofs that quality of supervision is of top-flight labor-relations importance. J. David House, for instance, demonstrated through testing that employees in general rate their wages *seventh* in a scale of values. They put the following six points ahead of the weekly pay-check: 1. Receiving help necessary to get results expected by the management. 2. Being encouraged to offer suggestions and try new methods. 3. Being told whether their work is improving. 4. Certainty of getting a fair hearing and a square deal for grievances. 5. Certainty of promotions going to those who are best qualified. 6. Being encouraged to seek advice.

With the help and encouragement of management, every foreman can go a long way toward realizing the ideals expressed in these tests and surveys. An effective way to do it is through the 4-point formula, which helps the foreman to embrace the full range of his responsibilities, both to the company and to the employees in his charge.

The Foreman as an Instructor

Both in "breaking in" new employees and in preparing others for promotion to higher jobs, the foreman's function as an instructor is of key importance. Every worker wants to be employed at his highest skill, not only because of the higher earnings involved, but also because of the tremendous factors of self-respect and respect from fellow-workers. The foreman or supervisor who patiently trains the members of his department, avoiding "show-off" tactics and patronizing gestures, is bound to win cooperation from his staff.

One of the fundamental mistakes in training is to assume that the new worker knows more than he really does about the particular operation, machine or material. Another basic fault is impatience on the part of the instructor, who, because the task is easy for him to do, ex-

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Glasshouse Friggers

Glass Dumps

By T. TAYLOR SEAGO

These paradoxical friggers, at once robust yet delicate, are an infinite source of pleasure to collector and layman alike. They are found in great variety of form and decoration, but the three examples shown will suffice to illustrate the technique employed in their manufacture.

The two most frequent types encountered are those containing flowers or masses of bubbles: it is comparatively rarely that one finds such a specimen as that shown in the first illustration.

This last is one of the famous Bristol dumps—so called because it was made in that area. It is a highly decorative piece and is composed of a clear yellowish-white glass, enclosing long-stemmed, tinted flowers "growing" from a mass of multi-colored glass at the base. This glass at the base is often termed a "flower-pot," since it usually takes the form of a roughly conical vase. In this Bristol dump, however, the pot is mound-like in shape and has been formed by embedding in the "core," or first gathering, a great number of small, broken pieces of glass, mostly colored opals. Into this base, after reheating, have been arranged the flowers themselves which had been previously made up from streaked opal glass, touched here and there with colors of glowing ruby, blues, purples, greens and yellows. A final gathering of clear molten glass over all this completed the frigger, which was then detached from the pontil, after final shaping. The colored mound occupies only half the diameter of the base, but owing to the magnification due to the surrounding glass, it appears to cover the whole base. Around the petals of the flowers have been trapped shining bubbles of air and these add in no small measure to the beauty of this frigger. These silvery bubbles are characteristic of the genuine Bristol dump, and it is observed that fakes do not normally possess this feature. They are best observed by cupping the hands round the dump, and so cutting off all side lighting. These air traps then appear as "ghost petals" just above the petals of the flowers themselves. The colors, too, have a mellow quality in the genuine article, whilst in imitations the tints are too garish to be æsthetically pleasing. The example shown is 3½ inches high and 2¾ inches diameter at its widest point.

The long narrow "bubble" dump which we illustrate is of bluish green glass and is nearly 6 inches tall, being 3 inches in diameter at the middle. The bubbles have been formed in a series of operations, all precisely similar. A ball of glass was gathered on the pontil and allowed to cool somewhat, when it was pierced deeply at intervals, so forming depressions more or less conical in shape. More molten glass was gathered around this core, and of course the air enclosed tended to expand, forming bubbles of various shapes and sizes. This operation was repeated again and again until the maker was satisfied. No doubt the lower, elongated bubbles owe their shape partly to the maker swinging his core on the pontil in order to lengthen the mass somewhat.

The multi-flowered dump shown here is of pale sage-green glass and is 5¼ inches in height and 3½ inches in diameter at its widest point. It is a really fine example of its type and was made as follows: The "flower-pot" at the base was first made by gathering a small quantity of glass on the pontil, and after shaping, this was rapidly dipped into water which had been clouded by stirring into it pieces of clay or similar material. This had the effect of imparting a "crizzled," silvered appearance to the "pot." After reheating slightly, more molten glass

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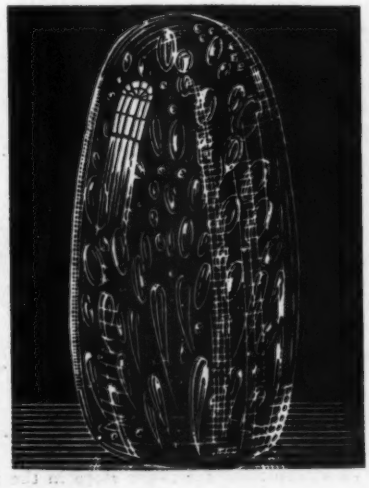


INVENTIONS AND INVENTORS

A Summary of United States Patents of Interest to the Glass Industry Issued During February

Feeding, Forming and Shaping

Among current Hartford-Empire patents is 2,340,782, the invention of Thomas Waugh relative to apparatus and methods for making hollow glassware by the fill and empty method of the suction mold charging type. Such a fill and empty method consists of gathering a charge by suction into a parison mold, discharging or emptying the inner portion of the charge to leave a shell or blank within the mold, and finally blowing the bottle to final form. Waugh's refinements as shown in Figs. 1 to 5, provide rather exact means of controlling the weight of the charge.

Fig. 1 shows the charge being drawn into the mold by suction. The bushings 16 are an important part of the invention, because the size of the charge is controlled by altering the degree to which they extend into the mold body.

Fig. 2 shows a portion of the charge returned to the gathering pool, and in Fig. 3 the assembly has been lifted from the gathering pool preparatory to shearing. The body mold sections have been parted and the bushings removed.

Fig. 4 shows the separation of the hollow glass body or parison from the pool. In Fig. 5 the final body forming mold assembly has been completed by the restoration of the body mold and the provision of a bottom plate. It should be noted that the body mold sections are the same ones used in the initial suction operation of Fig. 1.

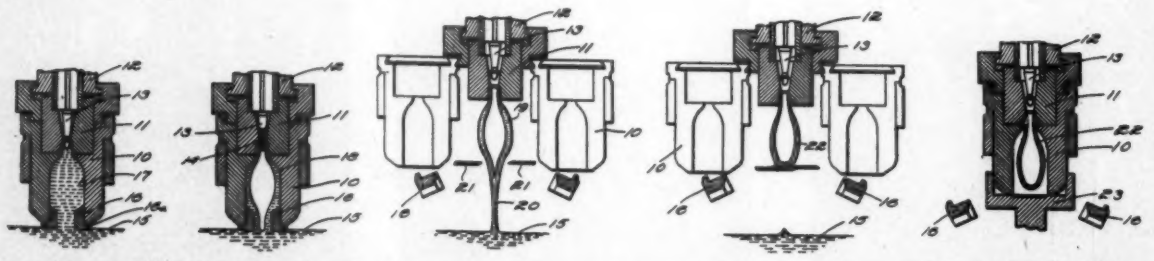
William T. Barker, Jr., of West Hartford, Conn., has added patent 2,340,729 to the important Hartford-Empire group covering feeding devices. As indicated in Fig. 6 he provides a feeder having two or more outlets so that charges may be provided simultaneously to several molds or to more than one cavity of a plural-cavity mold. A reciprocal plunger, working in a well of usual design, is controllable so as to allow fine adjustment in all directions to correct for the unequal discharge which would be the primary problem in any multiple orifice feeder. The patent describes the various control and adjustment devices which are a part of the invention. Separate pairs of shears sever each mold charge. The charges, shown at 45 and 46 in the drawing, are steadied and guided at the time of their severance, and are then guided to their respective mold cavities by suitable delivery troughs.

Miscellaneous Processes

Patents issued for methods of making vacuum tubes included 2,340,459 to William W. Eitel of San Bruno, Calif. (Eitel-McCullough, Inc.), 2,340,879 to Clarence A. Horn of Newton, Mass. (Raytheon Production Corp.), and 2,342,609 to B. S. Ellefson of Emporium, Pa. (Sylvania Electric Products Co.). Eitel's patent concerns high frequency tubes in which it is desired to have a heavy metal lead which just barely penetrates the glass envelope. His method is to heat the glass at the position where the seal is to be made, then to force the lead into the softened area but not entirely through it, and finally to abrade the glass from this area within the tube so as to expose the end of the metal. Horn's process yields a radio tube in which the stem serves as the tube base, and which carries lead-in conductors which also serve as the external contact pins. The Ellefson patent teaches means of embedding conducting leads into glass by coiling plastic workable glass around them and then flattening the glass into a seal by pressure application.

Louis Poglein of Jeanette, Pa. (McKee Glass Co.) received patent 2,342,486 for a covered glass dish having a wide top flange and an annular bead, the latter being for the purpose of engaging a similar bead on the cover so as to hold it into place.

Other patents included 2,340,465 to Charles Gerlach of Waukesha, Wis. (Michael Yundt Co.) for an automatic safety stopping mechanism for bottle washing machinery, and 2,340,812 to B. H. Koob of West Hartford, Conn. (Hartford-Empire Co.) for a ware stacker to pick up successive articles at a receiving station and to distribute them transversely across a lehr conveyor. This invention is applied particularly to handling glass blocks. They are picked up bodily by tongs and moved to the desired position. The apparatus which does this is set in motion by the arrival of a glass block at the pick-up station. It carries through the entire cycle of handling the block, and then returns to the pick-up station where it remains inactive until another block arrives. The tongs are operated by an air motor.



Figs. 1 to 5. 2,340,782: Waugh. These views illustrate successive steps in the manufacture of hollow ware by a suction fill and empty method.

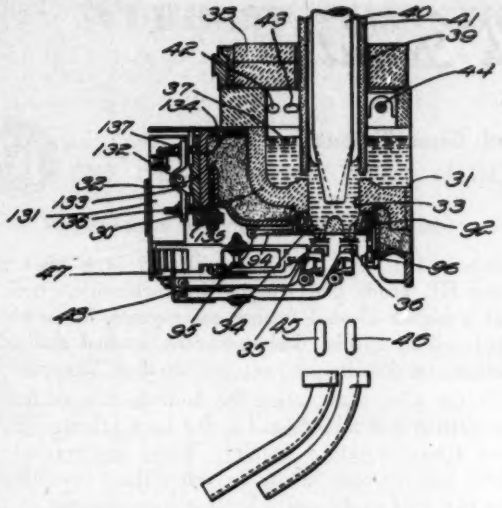


Fig. 6. 2,340,729: Barker. A feeder which has more than one orifice.

Sheet and Plate Glass

John E. Wiss of Columbus, Ohio, assigned to the U. S. Gypsum Co. his patent 2,340,840 for a plate glass setting composition comprising calcined gypsum, portland cement, potassium sulphate and calcium chloride. A typical composition follows:

Calcined gypsum	96.9-97.3%
Portland cement	2.5
Potassium sulphate	0.1-0.5
Calcium chloride	0.1

To prevent the formation of an iridescent film on plate glass during storage, possibly due to oxidation, Donald L. Wright of Westfield, N. J. (Standard Oil Development Co.), has devised a coating mixture made from a petroleum oil of low volatility (with a Saybolt viscosity less than 1,000 seconds at 100 degrees F.) to which are added 2 to 30% of an oil-soluble alkali metal sulphonate and a similar percentage of a fatty oil such as degras. This is patent 2,340,918.

Fig. 7 illustrates the novel apparatus devised by Milton A. Powers of Detroit for forming extremely thin sheets of glass, described in patent 2,342,891. His plans refer to sheets thinner than a thousandth of an inch. Such glass, he has termed glass tissue, and he mentions that its uses include those of mica, and of sheet insulation for electrical resistance. He has in mind glass so thin that it can be stored in rolls. In Fig. 7 glass is drawn from a supply pool through a die, 4, to form a narrow band with beads or ribs at each edge. It is then guided so that the beads diverge as they slide, each in a stationary channel, with the result that the band of glass is drawn outward into a thin sheet. Finally the beads are severed from the sheet by high voltage arcs and the sheet is rolled up. The stretching unit, 4-4, which comprises the central part of the illustration is housed between heating elements which are needed to give the glass workability.

Pittsburgh Plate Glass Co. patents included 2,340,469 to Frank W. Hall, of Tarentum, Pa., for a multiple sheet glazing unit, and 2,340,476 to L. A. Keim for a light polarizing unit. This is a laminated assembly comprising a pair of glass plates bonded together by an intermediate layer consisting of a sheet of polarizing material of particular composition involving polyvinyl acetal resins.

Patent 2,341,524 issued to David Bezborodko and Charles Zucker of Nice, France, and now held by the Alien Property Custodian, concerns a combined machine for surface grinding and polishing plate glass. A hand glass cutter is described in 2,341,030 which was granted to A. T. Fletcher of Bristol, Conn.

Two patents assigned to the American Window Glass Co. are 2,343,035 granted to Theodor G. White of Pittsburgh for apparatus for scoring cover glass sheet, and 2,340,807 granted to S. F. Grein and P. G. Magrini of Belle Vernon, Pa., for a machine for automatically han-

(*Continued on page* 186)

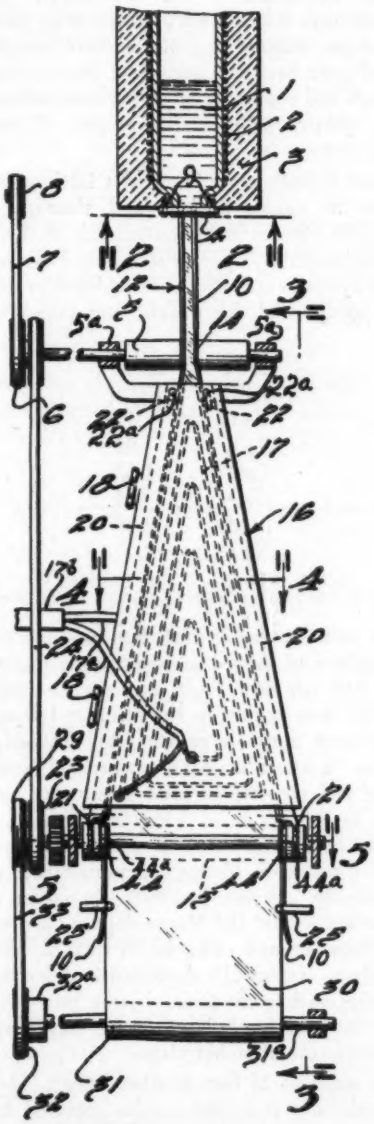


Fig. 7. 2,342,891: Powers. Drawing glass sheet which is less than a thousandth of an inch thick.

Research Digest

Practical Interpretations of Glass Technology

Beneficiation of Del Monte (Calif.) Sands

In a recent (December, 1943) Bureau of Mines Report of Investigations (R.I. 3740), John Dasher, Robert R. Rough, and Frank L. Bacon have described a series of experiments undertaken to beneficiate a California sand so as to produce a raw material, suitable as a source of silica, for a flint glass of good color.

For many years, Belgium ballast sand had been used as a glass sand but within the last ten years it has become more economical to use local sands. Deposits of purer sand were treated and used for some time; but the supply became limited and means were sought to beneficiate the more bountiful supply of impure beach sands. These sands are composed of 50 per cent feldspar and 50 per cent quartz, with small amounts of iron-bearing minerals.

The most objectionable impurities in these West Coast sands are the oxides of iron and alumina. The Del Monte (Calif.) beach sand contains about 0.13 per cent Fe_2O_3 and about 11.0 per cent Al_2O_3 (the latter being furnished by the large amount of feldspar present). The complete analysis of the washed and tabled sand is as follows:

SiO_2	82.42%
Al_2O_3	10.81
Fe_2O_3	.125
TiO_2	.02
CaO	1.55
BaO	.14
Na_2O	2.80
K_2O	2.47
Total	100.33

For the manufacture of flint-glass containers the maximum quantities of these two impurities permitted in the sand are 0.05 per cent Fe_2O_3 and six to eight per cent Al_2O_3. The iron occurs in the sand as follows: Traces of iron-bearing minerals resistant to weathering, ferruginous clay stains on the sand grains, and iron minerals not visible and possibly in solid solution or as colloidal inclusions in the grains of feldspar or quartz. A good part of the iron in the sand is present in the traces of iron-bearing minerals, biotite, ilmenite, garnet, monazite, and hornblende. Biotite is present in larger quantities than the others. The Del Monte deposits are rather uniform in character and sufficient in quantity for a long-term supply as the sand is deposited in a series of dunes several miles square in area. In the past the deposits have been worked for industrial sand and sand for use in the manufacture of amber glass.

Various methods of beneficiation were tried on a laboratory scale and from the results obtained it was decided that a suitable product could be obtained by washing and tabling, and by flotation of the feldspar and biotite. This has been accomplished in a pilot plant using HF, crude lauryl amine hydrochloride, crude oil, and a higher alcohol frother as reagents, in an air-agitated cell of special design, on the washed and tabled sand containing 10 per cent coarser than 35-mesh.

In the pilot plant set-up the flow sheet is as follows: the washed and tabled sand is fed by a vibrating feeder from a hopper into a launder. Water and reagents are added and the pulp enters the cell without conditioning. The first foot of the cell is used as a conditioner by raising the overflow lip with wood strips. This gives the oil a chance to become worked into the pulp. The flotation under-flow and the froth product flow by gravity into a Dorr Simplex rake classifier (used as a dewatering drag), and into a dewatering cone, respectively. Rake product and underflow are filtered and washed on a Denver Duplex pan filter. Classifier and cone overflow water might normally have been recirculated to reduce consumption of reagents, but the relatively large exposed iron surface of the laboratory equipment made recirculation impossible in the pilot-plant installation.

Although most of the biotite floats with the feldspar, removal of the remainder will lower the iron content from 0.05 to 0.04 per cent Fe_2O_3. This may be partly effected by prior flotation or by magnetic or electro-static separation.

An Improved Laboratory Polariscope of Simple Design

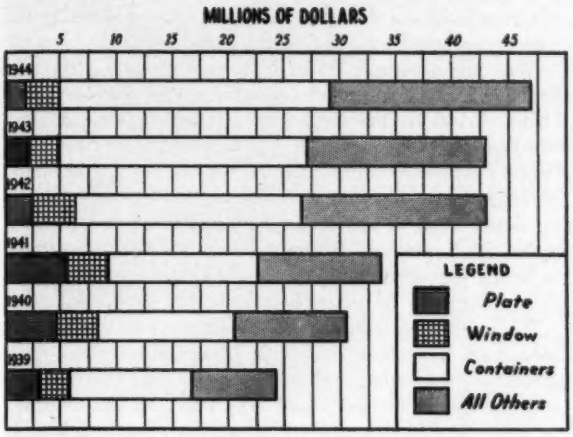
In the January 1944 issue of *The Bulletin of the American Ceramic Society*, J. Gallup describes an inexpensive home-made polariscope which has the following desirable features: 1—A uniform light intensity over the field; 2—A uniformly polarized field; 3—A uniform color over the field; 4—Binocular vision without eyepieces or lenses to cause eye fatigue; 5—A wide field of view; 6—Freedom from extraneous light, i.e., freedom from reflected room light; 7—A vertical system which allows the strained object under view to be laid directly over the bottom polarizer beside the strain standards, leaving both hands free for manipulating the standards; 8—A convenient arrangement for viewing small curved objects immersed in a beaker of liquid of appropriate index to remove reflection effects; 9—A direct-viewing arrangement without the confusing reversal of image which occurs with the use of a mirror analyzer; and 10—A readily removable tint plate.

The necessary equipment consists of a 3200° Kelvin bulb for the light source, a sheet of black Carrara glass which is set at the polarizing angle and is used as the mirror, a piece of Polaroid "J" film for the polarizer, a piece of Polaroid "H" glass for the analyzer and a piece of mica which is used for making the tint plate. The construction of the polariscope is given in detail.

CURRENT STATISTICAL POSITION OF GLASS

THE GLASS INDUSTRY'S INDEX

Production for the Month of January



Activity in the glass industry during January stayed at the same level as that of December, 1943. According to the Production Index, output during January was $47,000,000 as compared with $43,000,000 for the same month of 1943.

Plate glass production for February totalled 7,980,460 sq. ft., as shown by the report of the Plate Glass Manufacturers of America. This was an increase of 3 per cent over January, and of 67 per cent over February, 1943.

Glass container production during February totalled 7,771,359 gross, according to the Glass Container Association of America. This was a decrease of 5 per cent from January, and an increase of about 16 per cent over February, 1943. During the first two months of 1944 glass container production amounted to 15,974,174 gross, as compared to 14,032,525 gross for these months of 1943—an increase of approximately 13 per cent.

Shipments of glass containers during February decreased approximately 6 per cent from January and increased slightly more than 6 per cent over February, 1943. Cumulative figures for the first two months of 1944 reveal that shipments during this period were about 8 per cent higher than for the same period of 1943.

Inventories on glass containers for February were 4,426,379 gross—about 39 per cent less than the same month of 1943.

Automatic tumbler production for February was reported at 4,728,232 dozens, an increase of 12 per cent over February of last year. Shipments of automatic tumblers during February were 4,171,017 dozens, as compared with 4,210,340 dozens shipped during the same month of 1943. Finished stocks on hand at the end of February were 6,793,376 dozens.

Table, kitchen and household glassware: Manufacturers' sales of machine-made table, kitchen and household glassware were reported at 1,522,255 dozens for February, a decrease of 58 per cent from February, 1943.

Miscellaneous glass products manufactured in January were estimated at $18,000,000, the same as that reported for December, 1943.

GLASS CONTAINER PRODUCTION AND INVENTORY

(All Figures Are in Gross)

		Production Feb. 1944	*Stocks Feb. 1944*
Foods; Medical & Health Supplies; Chemical, Household, Industrials; Toiletries & Cosmetics	Narrow Neck	2,429,240	1,626,538
	Wide Mouth	2,726,973	1,227,363
Dairy Products		257,815	335,416
Home Canning		312,602	208,021
Beverages		540,963	338,934
Beers		722,101	151,264
Liquors		470,810	379,244
Wines		222,853	112,477
Packers Tumblers		88,002	47,122
Total		7,771,359	4,426,379

GLASS CONTAINER SHIPMENTS

(All Figures Are in Gross)

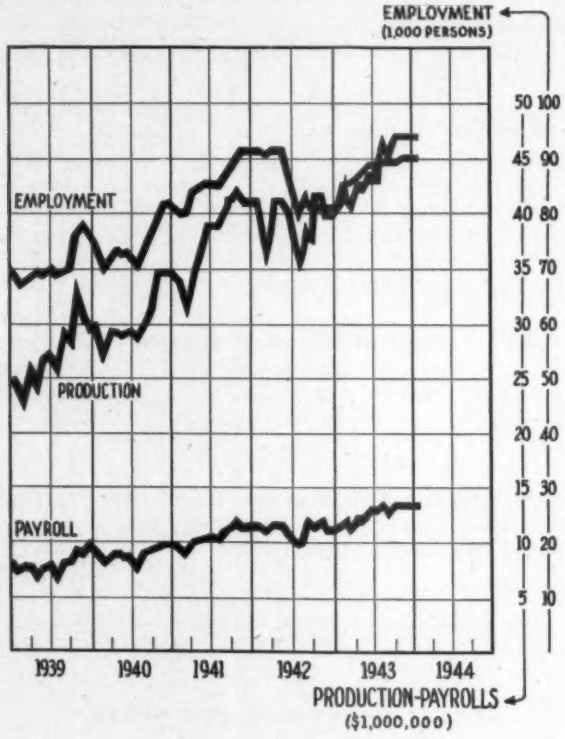
Narrow Neck Containers	*February 1944*
Foods	546,312
Medicinal & Health Supplies	1,015,241
Chemical, Household, Industrials	537,776
Beverages	496,730
Beers	712,312
Liquors	419,646
Wines	211,370
Toiletries & Cosmetics	396,093
Sub-Total (Narrow Neck)	4,335,480
Wide Mouth Containers	
Foods	2,080,455
Dairy Products	243,401
Home Canning	277,693
Medicinal & Health Supplies	221,963
Chemical, Household, Industrials	154,225
Toiletries & Cosmetics	168,118
Packers Tumblers	56,386
Sub-Total (Wide Mouth)	3,202,241
Total Shipments	8,031,738

Employment and payrolls: The number of persons employed in the glass industry during January totalled 91,000, the same number as shown for December. This compares with 85,000 employed during January, 1943.

Payrolls in January were estimated at $13,500,000, which is the same as reported for December, 1943. This is an increase of 12 per cent over January of last year.

GI THE GLASS INDUSTRY'S INDEX

Monthly Trends Through January, 1944



WAR PRODUCTION BOARD ORDER ON FIBROUS GLASS TEXTILES

Effective April 1, 1944, fibrous glass textiles have been classed as undesignated products under the terms of General Scheduling Order M-293, and deliveries of such products will be scheduled on the basis of specific War Production Board directions, WPB recently announced.

WPB will inform fibrous glass textile manufacturers when they are required to file their monthly shipping schedules with the WPB Cork, Asbestos and Fibrous Glass Division. When such schedules are filed upon WPB request, they become frozen delivery schedules, and may not be interfered with except upon WPB order.

The term "fibrous glass textiles" has been defined to specifically include cloth, tape, cord, sleeving, thread, yarn, sliver, M.Q. webbing and other products fabricated wholly from textile type glass fibers.

CARTON PREFERENCE RATINGS FOR GLASS REVISED UPWARDS

Through the efforts of the Office of Civilian Requirements, John R. Hostetter, Chief of the Glass Unit, W.P.B., and the Durable Goods Division of the W.P.B., the War Production Board Urgency Rating Committee has consented to an upward revision of the preference ratings which had been assigned to tableware, kitchenware and several other glass items. The official Urgency Rating Committee rating changes are: glass tableware and kitchenware from AA-4 to AA-3 and glass industrial and precision parts from AA-5 to AA-2x.

With the accomplishment of these revisions it remains for the WPB Corrugated Containers Division to amend Order P-146 to the extent of embodying the changes. The amendment of P-146 would then place the glass manufacturers in their proper relationship for securing corrugated cartons with items of similar end use. While no definite date is known for the issuance of the amended order the Containers Division states that the amendment is being prepared by its legal department and that the new order may be expected reasonably soon.

While the preference rating changes on corrugated containers have been favorable to the above mentioned divisions of the glass industry it seems that Order L-317 will shortly be revised which will affect all commodities in Schedule List A which includes most glass articles. It is more than likely that the manufacture of the items included in Schedule List A will be cut from 80 to 70 per cent of the amount of corrugated containers used in the base 1942 period. It is believed barely possible—although the outlook is not too bright—that certain essential glass products may be permitted to remain at 80 per cent.

OWENS-ILLINOIS MICROPORITE AS A PACKING MATERIAL

During this war, much use has been made of the practice of dropping supplies of all sorts from airplanes. If these are breakable, or apt to be damaged by the impact with the ground, they are sometimes attached to parachutes; but then, the parachutes are apt to cause them to drift from their intended landing point, and this may be quite awkward on tiny coral islands or in the dense jungle country.

An officer has discovered that if you take an ordinary carton and line it with an inch or two of Microporite, you can throw the box loaded with bottles, electric lamp bulbs and ordinary eggs from a hundred-foot water tower on to frozen ground, and thereafter the lamps will light and the eggs be unbroken. The bottles have to be separated with bits of Microporite, and the eggs are placed in cavities burrowed into it.

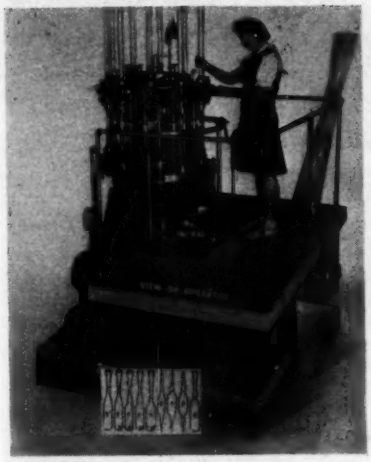
He is now going to take them up in a plane and drop them from a greater height. Perhaps after a while we can land our paratroopers in cartons lined with Microporite. At any rate, the idea seems to have possibilities.

From *Preston Paragraphs*, March 1944.

BUY WAR BONDS

NEW EQUIPMENT AND SUPPLIES

LARGE AUTOMATIC AMPULE MACHINE



The Eisler Engineering Company of Newark, N. J., has just placed on the market an improved automatic machine for the manufacture of large ampules.

As illustrated, the operator feeds the machine by putting the glass tubing, in its full length of 5 feet, into the revolving chucks, connected with the slowly rotating spider. The tubing passes then in uninterrupted course, three sets of burners, properly located in the machine, which in successive operations of drawing, constricting and bottoming—adequately applied to the now hot and plastic glass tubing—performs the desired shaping of the ampule, which thereafter is automatically cut off and discharged to a shelf. Before a new turn starts the glass tubing is lowered by automatically releasing momentarily the tube-holding chuck jaws.

The improvement in the new construction of this machine is a special device built in, consisting of a balancing equipment for the relative heavy glass tubing, combined with an abutment plate. This plate supports the tubing safely during its downward motion for the next position, when released from the chucks, thus preventing an abrupt drop of the tube and limiting shrinkage to an absolute negligible minimum.

Controlled valves and pilot burners admit action of the fires only at the proper instant. Burners and chucks are adjustable for making different sizes and types of ampules.

This 10 position machine is supplied with chucks that can handle tubes from 18 to 35mm. diameter, according to the opening of the jaws. With each revolution of the spider 10 ampules are automatically completed. The approximate production of the machine per hour is 800 for the 18mm. respectively 410 for the 35mm. tube. The machine requires ½ HP motor. One operator can attend 1 to 2 machines. The height of the machine is 90 inches. Required gas pressure 13 inches water column, air pressure 2-½ lbs., oxygen pressure 3 lbs. per square inch. The net weight about 2000 pounds.

DOUBLE RATIO SCALE SIMPLIFIES COUNTING SMALL PARTS

The Howe Scale Company of Rutland, Vt., offers a new double ratio scale which is said to be especially adapted for counting small parts because of the unusually high sensitivity provided by a third pan attached to the lower beam lever. This scale is designed for the quick, accurate counting and weighing of materials in shipping, receiving and production departments as well as for inventory and similar counts of small parts.

NEW 4-POINT GAS ANALYZER

Chemists, metallurgists and other engineering executives will find much of interest in the new industrial 4-point Gas Analyzer developed by The Cambridge Instrument Co., Inc., of New York City. It provides simultaneous analysis and continuous graphic record of the amounts of Oxygen, Carbon Dioxide, Carbon Monoxide and Hydrogen in a sample of combustion products. The instrument is useful in processes wherever knowledge of the amounts of gases mentioned is required.

A continuous record of the analysis is provided on a 10″ strip chart, and the four different registrations (one of each gas) are shown by different colors and numbers on the chart.

CONDUCTIVE COATING MATERIALS

The Electrochemicals Department of E. I. du Pont de Nemours and Company, has developed a new ceramic type composition producing electrically conductive coatings that may be applied to a wide variety of non-conductors including glass, plastics, porcelain, soapstone, wood, cloth and paper. These coatings can be applied to non-conducting base materials by spraying, dipping or brushing, followed by air drying and, in some cases, baking.

Several different formulations of the new material are being produced, each designed to meet the varying requirements of different base materials and degrees of adherence and film toughness. The coatings are dull, metallic gray in appearance.

METAL SALT TABLET DISPENSER

The Standard Safety Equipment Company of Chicago announces that their all metal salt tablet dispenser is again on the market after a two year absence because of material restrictions.

The dispenser comes in two sizes—Junior and Midget—and is guaranteed against mechanical failure for five years from the date of purchase. The larger capacity of 1500 ten-grain tablets is made entirely of a corrosion-resistant alloy. The smaller unit has a capacity of 350 ten-grain tablets and has proved effective for use in stores, offices and small shops. Available promptly on an AA-1 rating.

The company also has an all plastic salt tablet dispenser which comes in these same two sizes although not the same shape—referred to as Fairway Junior and Fairway Midget—and which is available without a priority rating.

CIRCULAR SLIDE RULE

The Tavella Sales Company of New York City has just placed on the market its new Monitor Slide Rule which is made in circular form. The scales are on a disc six inches in diameter, and length of multiplication and division scale is 13.8 inches as against 10 inches of the regular 10 inch slide rule.

Tests have proven that the average accuracy of the Monitor Slide Rule in making rapid calculations is within ¼ of 1%. This slide rule is made of white vinylite and is grease and waterproof.

SYNTHETIC RUBBER GLOVES ON MARKET

Synthetic rubber is now being used by the B. F. Goodrich Company in the manufacture of two types of industrial gloves. They can be sold to anyone who qualifies under Rubber Order R-1.

Sizes and gauges of the two types were carefully worked out to meet the greatest average demand, and it is claimed by the Goodrich Company that the synthetic rubber gloves are equal in most respects to those made from natural rubber. They are as good as natural rubber gloves in resistance to acids, and at the same time as grease and oil-resistant.

(*Continued on page* 177)

A.C.S. PROGRAM . . .
(*Continued from page* 165)

Wednesday A.M.

11. Qualitative Spot Tests for Minor Constituents in Glass

By Samuel Zerfoss and R. L. Hess, Pennsylvania State College, State College, Pa.

A procedure is outlined for routine qualitative analysis of certain minor constituents of glass by means of micro-spot tests using organic reagents according to the technique of Feigl. The theory, details, interferences, and limits of detection of various chemical reactions involved are briefly outlined. A technique is discussed for the non-destructive testing of glass specimens. The method shows promise as a practical laboratory and plant tool.

12. Energy Additivity in Glasses

By Maurice L. Huggins and Kuan-Han Sun: Eastman Kodak Company, Rochester, N. Y.

Energies of dissociation into the component ions have been computed for about fifty oxides. From these and the coordination numbers, "ionic contact energies" have been computed. These may be used additively to compute approximate ionic dissociation energies in crystals and glasses in which each "metallic" atom is surrounded as in its simple oxide. Deviations from additivity result from changes in coordination number. The ionic contact energy of a Si-O contact depends also on whether the oxygen is in contact with two silicons or only with one (plus other more electropositive atoms).

13. Effect of Substituting MgO for CaO on Certain Physical and Chemical Properties of Typical Soda-Lime Glasses

By General Research Laboratory: Owens-Illinois Glass Company, Toledo, Ohio.

In base glasses containing (*a*) 14% of sodium oxide, 12% of calcite lime, and 74% of silica and (*b*) 16% of sodium oxide, 10% of calcite lime, and 74% of silica, magnesia (MgO) was substituted in steps of 2% for CaO. The effect of the substitution on liquidus temperature, viscosity, fiber softening point, and the resistance of the glasses to dilute acid and to distilled water is described.

14. Nickel-Bearing Diopsides

By M. A. Knight and F. W. Preston: Preston Laboratories, Butler, Pa.

The liquidus has been determined for the binary system $CaO\text{-}MgO\text{-}2SiO_2$—$CaO\text{-}NiO\text{-}2SiO_2$. Studies have been made on the partial substitution of nickel oxide for magnesia in dolomitic window glasses; the resulting changes in the liquidus temperatures and in the primary phase were investigated. The application of these results to the production of colored sheet glass is discussed.

15. Effect of Temperature on Homogenizing Rate of Soda-Lime-Silica Glass

By R. L. Tiede and F. V. Tooley: Owens-Corning Fiberglas Corporation, Newark, Ohio.

The rate of homogenizing with respect to temperature of a soda-lime-silica glass, under conditions of minimum convection mixing and in the absence of refractory materials, was studied, using the centrifugal-density spread technique. A constant melting period of four hours was observed and the temperature interval from 1230° to 1450° C. was covered in 38° increments. Increasing temperatures within the limits observed were found to have a quite limited effect on the homogenizing rate. This result was studied and interpreted further in terms of surface volatilization, composition of top and bottom glass, and diffusion mixing.

16. Lewis Acid-Base Theory Applied to Glass

By Kuan-Han Sun and Alexander Silverman: University of Pittsburgh, Pittsburgh, Pa.

A comparison is made of the classical, the Bronsted, and the Lewis theories of acids and bases. After showing that neither the classical nor the Bronsted theories can be applied to reactions involved in the production of glass, the Lewis theory is applied. Structural formulas are shown which illustrate the application of the Lewis theory.

Wednesday P.M.

Symposium on Optical Glass *(Parlors B and C)*

Concurrent Symposium on Glass Furnace Operation (Cardinal Room)

18. Light Absorption of Iron in Various Base Glasses

By W. A. Weyl: State College, Pa.

It is well known that the tinting power of iron depends on its state of oxidation. The light absorption of ferric oxide, ferrous oxide, and a combination of both will be discussed. In glasses of widely varying composition, such as optical glasses, the role which the ferric ion assumes in the structure of glass must be considered.

19. Chemical Reactions of the Surface of Optical Glass: I-II

By H. C. Hafner and N. J. Kreidl: Bausch and Lomb Optical Company, Rochester, N. Y.

Theoretical and practical aspects of surface cleaning and surface treatments are presented.

20. Deterioration of Glass in Tropical Use

By Frank Jones: Bausch and Lomb Optical Company, Rochester, N. Y.

The high humidity found in some regions is detrimental to lenses not only because of slow reactions between moisture and glass but also because the moisture promotes the growth of fungi which may cover the surfaces of lenses and prisms, rendering them opaque. Glass, itself, is not a food for fungi and little damage results if all materials from which a fungus could draw nourishment are excluded from the environment. Bad fungi damage may result where certain microscopic insects common to the tropics are permitted to infest the room or case in which an instrument is stored.

21. Precision Apparatus for Rapid Determination of Indices of Refraction and Dispersion by Immersion

By Conrad A. Faick and Bernard Fonoroff: National Bureau of Standards, Washington, D. C.

A new immersion method for determining indices of refraction and V values, employing the double-diaphragm method for securing oblique illumination, is described. The average error in the determination of indices of refraction based on 144 measurements is 2×10^{-5}; the maximum error is 5×10^{-5}. Complete measurements of the indices of refraction for the sodium D line and the hydrogen C and F lines may be made in approximately 1½ hours, and with these the V values may be calculated with an average error of 0.1 and a maximum error of 0.8.

22. Variations of Refractive Index of Glass in the Annealing Region

By Harold McMaster: Libbey-Owens-Ford Glass Company, Rossford, Ohio.

The refractive index of a chilled fiber of borosilicate glass was found to increase according to the equation, $1/(N_\infty - N) - 1/(N_\infty - N_0) = At$, where N_0 is the equilibrium index and A is a constant at constant temperature. Index data were extrapolated according to this

equation to give N_s for several temperatures between 900° and 1100°F. The change of A with temperature was found to be well represented by the equation $\log A = K/T + C$, where T is the absolute temperature and K and C are constants.

23. Non-reflecting Films

By Frank Jones: Bausch and Lomb Optical Company, Rochester, N. Y.

A general survey of the optical properties and the durability of several types of thin coatings applied to glass to reduce the light lost by reflection from polished surfaces is presented.

24. Time Problem in Annealing

By Aniuta Winter. Ecole Libre des Hautes Etudes, New York, N. Y.

The study of variation of refractive index of a glass as a function of temperature and time in the transformation region permits the determination of the shortest annealing schedule necessary to reach a given refractive index and a given degree of homogeneity. For a particular glass the best annealing, i.e., the best stabilized state, corresponds to the highest refractive index. This maximum of stabilization is needed only for a few uses of great precision. For many other purposes, a glass less stabilized can be used if it is sufficiently homogeneous.

The speed of variation of refractive index at constant temperature changes rapidly with temperature in the transformation regions. Equilibrium is reached in a few minutes near the upper limit of this region, but several hundred hours are required at the lower limit. By making proper use of this rapid variation of the speed of transformation within relatively small limits of temperature, an annealing schedule can be established to obtain a fairly high degree of homogeneity without reaching the highest value of refractive index but with enough stability for many practical purposes.

This result is obtained by freezing the glass at a certain state of equilibrium corresponding to a temperature at which the transformation is slow enough to be neglected during the subsequent rapid cooling which insures homogeneity. For many practical applications, this procedure permits the attainment of an adequate degree of homogeneity in a considerably shorter time than would be necessary to reach a higher refractive index which may not be essential. The degree of homogeneity obtained is also the best possible for a given length of annealing schedule. For each particular use of glass, the degree of annealing needed is to be determined and corresponding cooling curves then established.

25. Optical Glass from Viewpoint of Lens Designer

By R. Kingslake: Eastman Kodak Company, Rochester, N. Y.

The glass used in the manufacture of lenses must of course be chemically stable and substantially free from bubbles, color, and striae. The lens designer is then concerned only with the refractive index and the dispersive power of the available glasses. Because practically every new lens must be achromatic, the positive elements used in it must be made from glass having a low dispersive power; the negative elements must have a relatively high dispersive power. The choice of refractive index is determined by many conflicting factors inasmuch as the only "tools" available to the designer for the correction of many different aberrations are the radii of curvature of the lens surfaces, the thicknesses and air spaces, and the refractive indices of the glasses. The range of optical glasses commercially available and the reasons underlying the designer's selection of glass for different kinds of lens are discussed.

Wednesday P.M.

Symposium on Glass Furnace Operation

(Cardinal Room)

Concurrent Symposium on Optical Glass (Parlors B and C)

26. Observations on Fuel Oil Consumption in Similar Container Glassmelting Furnaces

By K. C. Lyon: Armstrong Cork Company.

A study has been made of heavy oil consumption in five similar glass furnaces melting bottle glass over a period of several campaigns. The effect of load, furnace age, and other factors on fuel requirements is indicated.

27. Value of Automatic Combustion Control and Its Effect on Design and Operation of Furnaces

By E. G. Smith: Amsler-Morton Company.

The quality and color of glass can be largely controlled, assuming that the raw materials or batch are delivered to the furnace in the proper manner and an approved furnace design is used. Proper furnace design combined with automatic combustion controls will increase tank capacity.

28. Application and Results in Use of Automatic Control in Glassmelting Furnaces

By W. H. Hasselbach: Libbey-Owens-Ford Glass Company, Toledo, Ohio, and F. E. Early: Askania Regulator Company.

The application of modern automatic control equipment such as combustion and furnace pressure control to glassmelting furnaces is described, and the improvement in over-all furnace performance which may be expected from their use is noted. Actual results obtained with glassmelting furnaces equipped with automatic controls from a standpoint of fuel savings, reduction of furnace maintenance, and improved product quality are given.

29. Fume or Vapors from Molten Glass

By C. A. Bradley, Jr.: Corning Glass Works.

Molten glass baths are compared to solutions of more or less volatile constituents. Loss of the volatile materials is discussed as well as some effects on glass composition and properties and cord and stone formation.

30. Round-Table Discussion

(*a*) *A. W. Dodge: Hazel-Atlas Glass Company.*
(*b*) *W. W. Oakley: Corning Glass Works.*
(*c*) *J. W. Wright: Owens-Illinois Glass Company.*

R. H. BARNARD RESIGNS FROM OWENS-ILLINOIS

Preston Levis, president of the Owens-Illinois Glass Company, has announced the resignation of R. H. Barnard, who has held the position of Executive Vice President. Mr. Barnard, known throughout the industry as "Randy," was a member of the Owens organization for twenty-two years. Mr. Barnard has not announced his plans for the future as this issue of THE GLASS INDUSTRY goes to press.

• It is reported that the Continental Can Company has acquired a substantial interest in the Anchor Hocking Glass Corp. The stock said to have been acquired is that which has been held by the Goode interests. Attempts to confirm this rumor through the Continental company have been unsuccessful up to the time this issue goes to press.

World-foremost
...IN GLASS PLANT EQUIPMENT

Glass Melting Furnaces
Window Glass Tanks
Amco Lehrs
Lehr Loaders
Fuel Oil Systems
Plate Glass Furnaces
Gas Producer Systems
Recuperative Pot Furnaces
Continuous Grinding and Polishing Equipment
Batch and Material Handling and Storage Equipment
Sheet and Plate Glass Lehrs

Rolled Sheet and Plate Glass Plants
Complete Bottle and Tableware Plants
Complete Window Glass Plants
Modern Factory Buildings
Appraisals

The AMSLER-MORTON COMPANY
FULTON BUILDING • PITTSBURGH, PA.

NEW EQUIPMENT . . .

(*Continued from page* 173)

REX UNI-FLO CONVEYOR

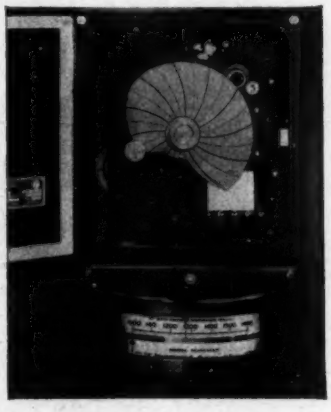
A new and unique conveyor for the mass handling of free-flowing bulk materials is the Rex Uni-Flo recently placed on the market by the Chain Belt Company of Milwaukee.

The Rex Uni-Flo is a conveying unit of the continuous-stream type. It is composed of a chain belt equipped closely-spaced scraper-carrier flight, which operates in an enclosed casing. With the entire cross section of the casing and all the space between the flights solidly filled with the material being handled, a continuous flow of material results.

This unit has a positive and unique discharge mechanism that definitely removes all material in the conveyor system on the point of discharge. It is completely self-feeding and no auxiliary feeding devices are required.

Rex Uni-Flo is flexible in application with a wide choice of basic units and few limitations as to layout. It can convey material horizontally, vertically, or at any angle. Because it is essentially a closed-circuit method of handling, it is clean and dust-free.

WHEELCO INSTRUMENTS TO ENFORCE DESIRED HEATING OR COOLING



The Wheelco Instruments Company, Chicago, Illinois, has introduced a line of instruments to enforce any desired heating or cooling program.

The instruments, called Chronotrols, are built around the company's established line of pyrometers, potentiometers, thermometers and resistance thermometers—all of which employ an electronic principle of effecting temperature control. They provide completely automatic temperature regulation, regardless of the changes in temperature desired for a given process or application.

Chronotrols are offered in 25 models, including ten for proportioning control and others for two-position on-off and three-position on-intermediate-off control for high- and low-temperature applications. Thermometer models are available in recording as well as indicating types.

AUTOMATIC OIL RECLAIMER

The Youngstown Miller Company of Sandusky, Ohio, has developed a new line of YM "Robot' Oil Refiners, designed to clean Lubricating Oil with continuous and automatic operation.

This machine, which is said to add new efficiency, convenience and economy to the widely used YM process of cleaning oil, utilizes common refinery earths available on the open market. It is capable of removing fuel dilution, acids, solid and colloidal carbon, dirt and similar matter; also, it can restore oil emulsified by water. When piston varnish and sludge deposits are present, the manufacturer offers a guarantee on removing them and preventing recurrence.

A single machine of this type can be installed to serve an entire power plant, whether large or small. Ability to restore transformer oils to 30,000 volt dielectric strength is also claimed for this machine.

CATALOGUES RECEIVED

General Electric Company, Schenectady, New York. The General Electric Company's Tube Division has just issued a four page bulletin (ET-12) containing a new quick-selection chart of electronic tubes for industry.

Glyco Products Co., Inc., Brooklyn, N. Y. This company is now distributing a 144-page catalogue "Chemicals by Glyco. The usual features have been retained and the manual is complete with formulae, suggestions and tables of useful chemical and physical data.

National Fire Protection Association, Boston, Mass. This 504 page volume, "National Fire Codes for Flammable Liquids, Gases, Chemicals and Explosives, 1943," brings together the many standards dealing with the explosive hazards of these materials. The several codes included are in the form of suggested ordinances or recommended good practice requirements, and are universally recognized as authoritative guides to the best practice. $3.00 per copy, postpaid.

R. T. Vanderbilt Company, New York, N. Y., has issued a booklet on "Pyrophyllite". This study is well illustrated with photographs, tables and graphs, and subjects covered in the text are: Geology, Properties, The Use of Pyrophyllite in White Ware Bodies, HS "Pyrax" Control, and uses of Pyrophyllite.

Wheelco Instruments Co., Chicago, Ill., has just distributed Bulletin A2-3, describing its line of Potentiotrols. The eight-page bulletin describes the potentiometer method of heat measurement, and explains the electronic principle employed to gain instant control in line with the temperatures recorded.

General Electric Company, Schenectady, N. Y. General Electric's pioneer electronic drive, Thy-mo-trol, for providing and controlling adjustable-voltage power from a-c lines, making possible the utilization of the advantages of d-c motors, is described in an attractive new 40-page bulletin (GEA-4025) recently issued by this company.

Surface Combustion, Toledo, Ohio, has just issued "Heat for the Glass Industry", an attractively bound twenty-four page book illustrating and describing numerous types of the most modern equipment for the heat treating of glass.

Photographs, drawings and detailed descriptions are given covering Continuous Annealing Lehrs, Radiant Tube Fired Decorating Lehrs, Direct-Fired Decorating Lehrs, Special Process Furnaces, Convexing and Bending Furnaces, Batch Type Lehrs and Ovens, Miscellaneous Furnaces, Recuperative Tanks, and Burner Equipment.

Clark Equipment Company, Battle Creek, Mich. The Clark Tructractor Division of this company has just released for distribution a new Vest Pocket Catalog which illustrates and gives specific data on every model of Clark Tructractor.

Of 3″ x 6″ dimensions, this 72-page booklet fits comfortably into a vest pocket.

Hauck Manufacturing Company, Brooklyn, N. Y., is distributing a handsomely bound book, "Hauck Industrial Combustion Data," free to combustion engineers, operating and maintenance engineers, plant executives, designers and builders of industrial heating equipment and metallurgists.

Its 112 pages contain "down-to-earth" data on industrial combustion and heating practice and the material is well illustrated with photographs, diagrams and charts. It is a splendid reference for any one concerned with the selection, installation, operation and maintenance of combustion equipment, either oil or gas, on furnace, ovens, kilns, retorts and other heat-processing equipment.

CATALOGUE & BULLETIN SERVICE

Current catalogs and manufacturers' service bulletins received in this department may be obtained by writing to THE GLASS INDUSTRY.

(*Continued from page* 163)

method may be discovered before the details slip the technician's mind. If an objective difference in technique is found, have the analyses done again by the same technician, but in the correct manner. If no assignable cause is found, allow the results to remain uncorrected. When the twelve month accumulation of twenty-four analyses has been completed, average the twenty-four results to obtain X_2. Also calculate the average of each month's duplicate tests. Calculate the standard deviation of the twenty-four individual tests σ_{24} and the standard deviation of the twelve monthly averages σ_{12}.

Calculate the limit of uncertainty of the average as follows:

$$LU_{av} = \frac{3\,\sigma_{24}}{\sqrt{24}}$$

Calculate the limit of uncertainty of the method:

$$LU_2 = \frac{3\,\sigma_{24}}{0.968}$$

Table II illustrates these calculations.

In the study of some forty basic analytical methods during the last two years the following relationships were found from the ratio of LU_2 to LU_1: (a) Ratios of 1.0 to 1.5 indicate that the variations result mainly from limitations of instrumentation. (b) Ratios of 1.5 to 2.5 indicate normal relationship between analyses made under the best conditions by one person and analyses made under routine laboratory conditions. (c) Ratios over 2.5 generally indicate considerable personal and seasonal variations that may be reduced without modification of the basic analytical method. (d) Duplicate determinations run at the same time are generally not truly random and the averaging does not improve the precision appreciably. The only justification for running analyses in duplicate is the additional safeguard afforded against an outright mistake, such as an error in calculation or an erroneous weighing.

TABLE II

Precision of Method under Routine Conditions

Month	Analyst	Specific Gravity at 25/4°C.	Average of Duplicates	Deviation of Individual from Grand Average, d_1	Deviation of Duplicate Average from Grand Average, d_2
	1	1.5850	1.58505	− 0.00003	+ 0.00002
January	1	1.5851		+ 0.00007	
	2	1.5848	1.58490	− 0.00021	− 0.00013
February	2	1.5850		− 0.00003	
	1	1.5846	1.58460	− 0.00043	− 0.00043
March	1	1.5846		− 0.00043	
	2	1.5851	1.58510	+ 0.00007	+ 0.00007
April	2	1.5851		+ 0.00007	
	3	1.5853	1.58530	+ 0.00027	+ 0.00027
May	3	1.5853		+ 0.00027	
	4	1.5849	1.58495	− 0.00013	− 0.00008
June	4	1.5850		− 0.00003	
	5	1.5849	1.58485	− 0.00013	− 0.00018
July	5	1.5848		− 0.00023	
	3	1.5854	1.58540	+ 0.00037	+ 0.00037
August	3	1.5854		+ 0.00037	
	3	1.5852	1.58525	+ 0.00017	+ 0.00022
September	3	1.5853		+ 0.00027	
	2	1.5847	1.58490	− 0.00033	− 0.00013
October	2	1.5851		+ 0.00007	
	2	1.5850	1.58500	− 0.00003	− 0.00003
November	2	1.5850		− 0.00003	
	6	1.5849	1.58500	− 0.00013	− 0.00003
December	6	1.5851		+ 0.00007	

Grand Average = X_2 = 1.58503

Standard deviation (individual determinations) = $\sigma 24 = \sqrt{\frac{\Sigma d_1^2}{24}} = 0.00022$

Standard deviation (duplicate averages) = $\sigma 12 = \sqrt{\frac{\Sigma d_2^2}{12}} = 0.00021$

Limit of uncertainty of grand average = $1.58503 \pm \frac{3\sigma_{24}}{\sqrt{24}} = 1.5849$ to 1.5852

Limit of uncertainty of method under routine conditions = $\pm \frac{3\sigma_{24}}{0.968} = \pm\ 0.00068 = LU_2$

Ratio of improvement by duplication = $\frac{\sigma_{24}}{\sigma_{12}} = \frac{0.00022}{0.00021} = 1.05$

Ratio of $\frac{LU_2}{LU_1} = \frac{0.00068}{0.00059} = 1.15$

SILICA SAND
for War Production

Sand for the war machine. A striking anomaly involving one of the most vital raw materials used in the production of machines, equipment and supplies for modern warfare.

Many American industries little known in connection with war production are daily supplying the raw materials from which the ships and guns and planes, the armament and ammunition are made. Silica Sand is such strategic raw material. In metallurgy including the casting of airplane engines; as the major raw material in the manufacture of glass; and in many finished forms Silica Sand is vital to our armed forces on land, at sea, and in the air.

Our modern plants and experienced personnel have enabled us to meet the heavy demands of war. Another strong and ready link in the chain of victory that is being forged by American industry.

Keystone Works, Mapleton, Pennsylvania

Sales Offices:
ARROTT BUILDING, PITTSBURGH, PA.—RED BANK, NEW JERSEY

PENNSYLVANIA GLASS SAND CORPORATION
LEWISTOWN, PENNSYLVANIA

BUY MORE WAR BONDS FOR VICTORY

Centralize Responsibility for

- BASIC PLANS
- BUILDING LAYOUT
- PLANT ERECTION
- COMPLETE EQUIPMENT
- CONTRACT LABOR AND OPERATION

in a TECO OVER-ALL CONTRACT

A TECO "OVER-ALL" CONTRACT covering designing, erection, equipping and operation of a glass plant centers responsibility in a well financed organization of proven ability.

By checking past accomplishments, the manufacturer can satisfy himself, in advance, as to TECO's competence and reliability. Thereafter, he will have but one place to look for results.

The plant layout will reflect long experience and a practical knowledge of the most efficient glass factories, assuring streamlined, economical straight line production.

Manpower for plant erection, from supervisors to laborers, will be available in TECO's own skilled crews.

That important unit – the melting tank – will be of TECO distinctive and superior design – equipped with refractories of types and makes proved to be most lasting and generally satisfactory.

Auxiliary machinery, valves and equipment will bear the stamp of TECO approval based upon past experience with them in various installations.

And finally, before your acceptance of the completed plant, it will be put into operation and proved to measure up to TECO's specifications and production guarantees.

TOLEDO ENGINEERING Company

GLASS MELTING *and* MANUFACTURING EQUIPMENT

EASTERN OFFICE 220 E. LEXINGTON ST. BALTIMORE MD. • • • 958 Wall St. TOLEDO, O.

(*Continued from page* 166)

pects the novice to grasp everything at once. Time spent in explaining complete details, and in demonstrating, step by step, the task to be performed, is time invested. But there is no "pay-off" unless the worker fully grasps the teaching, and this means that the instructor must watch the learner do the job "on his own." It also involves constant, but friendly, checking up throughout the first day or so of work, to be sure that everything is fully understood. Allowance must be made for nervousness on the part of the beginner, and this explains why the foreman's instructing should be done in a manner which puts the new man at ease.

Of course, instruction is not confined to the actual task to be performed by the new workers. Every job is surrounded with details, such as how to get materials or tools, what to do if the machine breaks or needs adjustment; what the rules are regarding rest periods and relief; safety practices and regulations; checking in and checking out, etc. In the well-ordered shop, such details will be covered in the Employees' Manual or handbook given them upon induction, but the foreman who takes his responsibilities as an instructor to heart will not be content to let the new worker get it all from the book. Instead, he will discuss these points in his own way, using the manual more as supplementary text or for illustration. This treatment insures that the manual will be referred to, and not be regarded as so much "fine print." And if the manual doesn't lend itself to this practice, you need a new manual.

The Foreman as Director

Naturally, foremanship goes beyond instruction, which, after all, is a means toward an end. That end is sustained production at the minimum cost in money, time, material and effort. Quality is also an essential factor; it does no good to step up the production of parts if the percentage of rejects also rises. Wear and tear on workers is as costly as wear and tear on machinery; the good foreman develops a faculty for sensing what can and cannot be done, so far as pace is concerned.

The ability to weld the individual workers into a team which functions smoothly as a unit is a touchstone of good supervision. This means that the foreman must have a harmonizing influence on the people who work under him. He cannot afford to ignore feuds or differences of opinion which lead to petty strife and bickering between the employees. Without offensively sticking his nose into other people's business, he must smooth out such tangles and irritations—or, if he finds that impossible—see that the inharmonious elements are transferred to other departments or other shifts. The practical jokers and the horseplay addict must be disciplined or separated, and the chronic complainers either satisfied or firmly dealt with (as must be done if their complaints are imaginary or unreasonable). The distinction must be drawn between the "natural-born fault-finder" who gets in other workers' hair and the employee with a sincere grievance.

Much of the literature on foremanship overlooks the foreman as an administrator who must deputize and delegate as well as directly supervise. The foreman who has to do everything himself, for fear that nobody else can handle it quite as well as he, is in as bad a position as the top manager who makes everything clear his own desk.

The Foreman as Interpreter

The foreman is a part of management, and a very important part at that. He, more than anyone else on the management side of the organization, comes into daily—even hourly—contact with the employees. In fact, to most of the workers the foreman *is* the management. Upon his shoulders falls the burden of humanizing and interpreting the various company policies which affect the employees. He is more than a mere liaison officer, however; in nine cases out of ten his decisions are final, and while these decisions obviously must conform with company policy, they are the foreman's own actions, taken on his own authority and responsibility. The body of these decisions tends to be regarded as company policy as time goes on. So the foreman's acts, as well as his words, ultimately reflect "the Company" to the workers.

Foreman-interpretation involves not only the explanation of company policy toward days off, minor infractions of rules and similar matters, but also the much higher type of action involved in handling grievances, when the foreman acts quasi-judicially. The measure of a foreman's capacity could well be his reception of complaints—whether he meets the employee half-way and tries to settle the matter equitably, or whether he resents the complaint as a reflection upon his own ability. To be fully effective, and to get the best results from the grievance machinery, the foreman should not merely *settle* complaints—he should invite them. The worker who finally speaks his mind must feel that the expression is well within his rights, and that no retaliation or discrimination will result. That is why the foreman hearing the complaint should lean over backward to assure the employee that he is listening to every word, and that all aspects of the matter are being given full consideration—with the employee's interest uppermost in the foreman's mind.

Some foremen dismiss the need for grievance systems by saying, "There isn't a man in my department who can't come to me and say anything he pleases." But they rob a grievance of its significance by being too casual about it. In short, they are acting as Bill Smith or Bob Jones instead of as management representatives. The good foreman is neither casual nor sarcastic in his dealings with his force; when faced with a serious complaint (and every complaint is serious to the complainer) his demeanor suits the occasion.

The Foreman as a Friend

Every progressive management wants to be considered the friend of all the workers, but it is obviously impossible for this to be literally true in all but the smallest companies. But the foreman, who is a part of management, certainly can be the friend of every worker in his department. He is the one person who knows everybody, and he can be either the amalgam which unites the group or the obstacle which keeps everyone apart. He is the one who sees when employees need help or counsel; if

(*Continued on page* 185)

GAYNER GLASS WORKS . . .

(*Continued from page* 162)

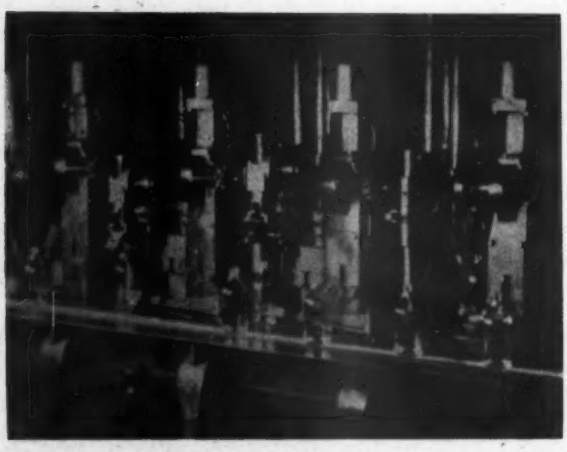
In view of the fact that the bricked-up oven method of annealing might seem antiquated and lacking in modern control, it is interesting to note and worthy of special emphasis that government specifications are extremely exacting for carboys.

The Bureau of Explosives specifies that walls must not be less than one-sixteenth of an inch in thickness and after the carboy is placed in its permanent wooden container the Interstate Commerce Commission, in conjunction with the Bureau of Explosives, puts the carboy through some tests which would probably remind a rookie GI of his first day of basic training.

Carboys are tested by these two government agencies not only at the plant where they are made but any time during the life of the big bottle inspectors will select samples at random where they are being used and subject them to the swing test. This gruelling test consists of filling the boxed carboy with water, raising it on a boom to a height of four feet seven inches and then dropping it on solid concrete. The specimen must take the shock on its bottom and sides.

Although this article has emphasized the family background of Gayner Glass Works, needless to say this plant, occupying as it does eleven acres with some six hundred employees, is not just a family affair. However, in addition to the direct descendants of the "founding father," John Gayner, the names of other individuals appear on the roster of the present management who through marriage have become members of the Gayner family. R. A. Godwin, son-in-law of the second Gayner, E. J., although inactive through ill-health at the present time, is vice president and director of the company. His son,, J. E. Godwin, is a vice president in charge of production, and E. H. Foster, another son-in-law of the late E. J. Gayner, is a vice president and holds the position of plant personnel director.

Seventy years of corporate existence is an enviable record and if aggressiveness, skill and pride of craftsmanship are the essential ingredients for business survival then Gayner Glass Works will be around for a long time to come.



Hartford I. S. Machines at Gayner produce pharmaceuticals, foods and general purpose ware.

GENERAL LIMITATION ORDER L-123 AMENDED BY WAR PRODUCTION BOARD

The War Production Board has announced a new minimum preference rating of AA-5 or better, designed to curtail distribution, for twenty-two classes of industrial equipment. Previous requirement had been A-1-c or better.

The classes of industrial equipment affected by the change in rating requirements, now covered by this amendment to Limitation Order L-123, include air filters, arc welding machines, baling presses, ceramic machinery and equipment, concrete products machinery, flexible metallic hose, tubing and fittings, oil filtering and re-refining machines, certain types of industrial ovens, paper shredders, pressure vessels (including air receivers), and wire working machinery, none of which were previously under this order.

The order also covers additional sizes and kinds of compressors formerly included under Limitation Order L-100; high pressure blowers formerly under Limitation Order L-163; heat exchangers formerly under Limitation Order L-172; pumps formerly under Limitation Order L-246; and fans and blowers formerly under Limitation Order L-280. A number of these kinds of equipment are also subject of General Scheduling Order M-293.

The amended order—L-123—no longer applies to conveying machinery and mechanical power transmission equipment, which are now covered by Limitation Order L-193.

Deliveries of new equipment covered by the amended order cannot be made by manufacturers, distributors, dealers or other persons except to fill orders rated AA-5 or better. The restriction also applies to deliveries from one department of an organization to another when the equipment becomes a component part of other machinery the organization may produce, or for installation and operation by such organization.

Certain exceptions covering varied uses of equipment and parts are also covered by the order.

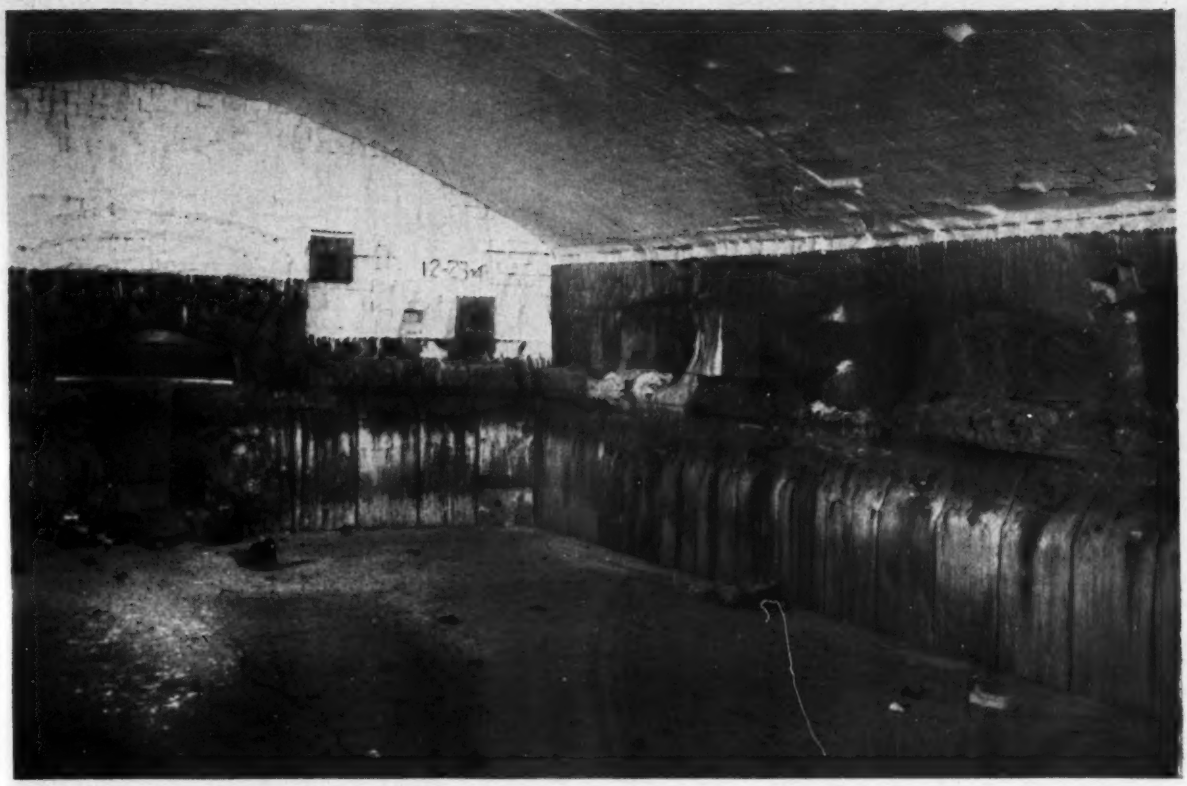
NEW MANAGERS APPOINTED BY BAILEY METER COMPANY

The Bailey Meter Company of Cleveland has announced the appointment of N. M. Barnett as manager of its Chicago Branch Office. Mr. Barnett has been connected with this organization for over twenty years and prior to his transfer to Chicago was manager of the Detroit office.

The managerial vacancy left in the Detroit office has been filled by Ralph T. Cowan, formerly of the Detroit and Cleveland Sales Offices of Bailey Meter Company.

Both of these men have specialized in the problems involved in applying metering and automatic control equipment to power plans and industrial processes.

• Mr. Bruno R. Neumann, until recently Senior Economist with the Planning Division of the War Production Board, has joined the National Foremen's Institute, Inc., as Labor Economist and Editorial Director. He will head the Institute's research and consulting service on labor economics and labor relations.



ANOTHER INTERESTING CORHART REPORT

LAST month we published four pictures of a Corhart* Electrocast tank which had run 1199 days and produced 104,890 tons of flint and amber glass (153.3 tons produced per square foot per life).

We thought you might want to study the detailed figures. So here they are:

TOTAL DAYS LIFE	1199
TOTAL IDLE DAYS	48
TOTAL OPERATING DAYS	1151
TOTAL TONS GLASS PRODUCED (FLINT AND AMBER)	104,890.78
AVERAGE DAILY TONNAGE LIFE	87.48
AVERAGE DAILY TONNAGE OPERATING DAYS	91.13
SQ. FT. PER TON LIFE	7.82
SQ. FT. PER TON OPERATING DAYS	7.50
TONS PRODUCED PER SQ. FT. PER LIFE	153.35

This furnace was built of Corhart Electrocast throughout the melting and refining-end sidewalls, throat, doghouse and breastwalls, plus outer course bottom blocks in the melting and refining ends, and a section of bottom in front of the doghouse. All blocks were Corhart Standard except the throat, several superstructure shapes and two melting-end sidewall blocks beneath the No. 1 port, which were Corhart Zed. (Note the two Zed sidewall blocks shown in the photograph). The furnace operated approximately four months on flint bottle glass, after which it was changed over to amber.

The furnace *did not fail.* No patch blocks or waterjackets were used at any time on Corhart materials. At the conclusion of the campaign it was found that the furnace could have been operated for several additional months.

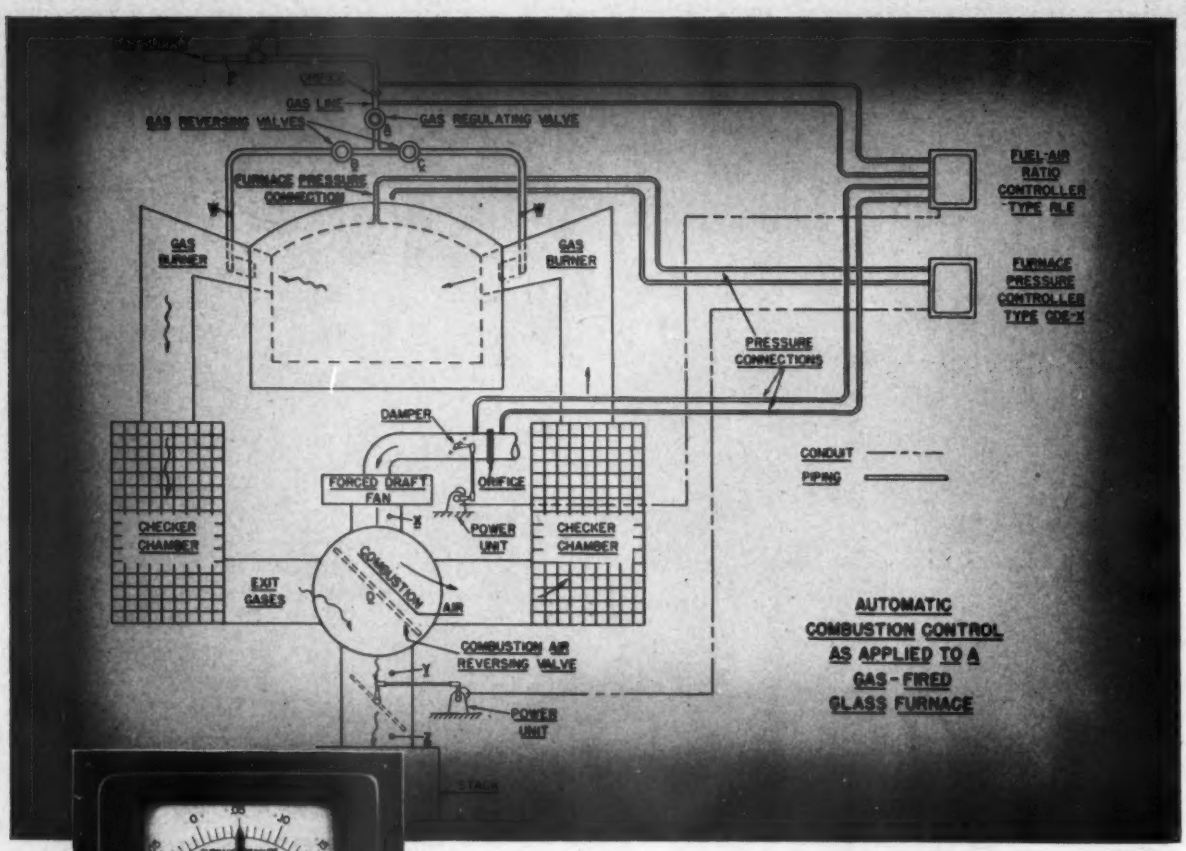
Corhart Refractories Company, *Incorporated,* 16th and Lee Streets, Louisville 10, Kentucky.

*Not a product, but a registered trade-mark.

QUALITY ECONOMY ENDURANCE

CORHART ELECTROCAST REFRACTORIES

444



HAYS AUTOMATIC
TANK PRESSURE CONTROLLER

HAYS AUTOMATIC
GAS-AIR RATIO CONTROLLER

Automatic

Combustion Control

for a

Gas-Fired Glass Furnace

FOR most efficient results two controls are used. See the installation sketch above showing instruments and connections. The Hays Automatic Tank Pressure Controller is connected to the crown of the furnace and actuates the stack damper. This control operates with a few thousandths of an inch of water pressure, so that there is always an accurate relationship between the pressure in the tank and the stack draft, which is controlled within very narrow limits.

A Hays automatic Fuel Gas-Air Ratio Controller is also used which, by measuring the intake flow of gas and air, maintains at all times a definite air-gas ratio, and a high percent of CO_2 in the stack or exit gases.

Each unit performing its own function works with the other to produce the best furnace temperature and pressure, and the most efficient atmosphere.

For oil, the same system applies, but the instruments are a little different.

For Full Information Send for Bulletin 43-552

The HAYS CORPORATION
COMBUSTION INSTRUMENTS AND CONTROLS
MICHIGAN CITY, INDIANA U.S.A.

THE FOREMAN'S PART . . .

(*Continued from page* 181)

he is friend as well as foreman they will bring their troubles to him. He works with them and fights for them, and is combination counsellor and champion as the case requires.

This does not mean that the foreman should be too hail-fellow-well-met, or that he should feel it incumbent upon him to treat his subordinates as social companions. The distinction in rank should always be apparent, at least in the shop. The foreman who weakens his authority and prestige by needless fraternizing is no more a friend thereby—and certainly less of a part of management. The Golden Rule is a surer foundation for friendship than trying to be "pals" with everybody.

Foremen Have Grievances, Too

One of the reasons why all foremen aren't measuring up to the standards named above is an indifference to their morale on the part of higher management. It is not exaggeration to say that in many companies the foreman has become almost a Forgotten Man. An investigation into the problem by the Field Staff of the Institute proved that many firms have been neglecting the fundamental rules of good foreman-employer-employee relations. Here is the gist of the foremen's complaints, plus the Institute's recommended treatment:

Complaint: "Other departments cut into our functions too frequently. As a result, we face lost prestige in matters which should be in our own domain."

Solution: Restore the foreman to his true function as the first line of personnel authority. Give him the right to approve new workers and suggest the discharge of any employee. Make him the first person to whom a grievance can be brought for settlement. When an appeal brings a reversal, let the foreman himself tell the employee. Consult the foreman in all questions pertaining to the earnings or transfer of workers in his department—and, above all, let your foremen know the extent and limitations of their authority.

Complaint: "We are supposed to be part of management, but we never know what management is thinking or planning."

Solution: Don't make it necessary for foremen to read the bulletin board in order to learn about the new rules. Always hold foreman conferences before making any substantial changes in company policy. Have the foremen, themselves, announce changes in company policy to their workers. If you use departmental bulletin boards, have all company notices signed on the bottom by the foreman of the department. Notices should instruct workers to ask their foremen for further data or explanations.

Complaint: "We share in the extra burdens of management, but our wages are not in keeping with the position we are supposed to enjoy. In some cases, workers under our supervision earn more than we do."

Solution: No foreman should receive less than 10 per cent more than the highest-paid worker beneath him. A margin of 15 to 25 per cent is even better. File with the Treasury Department for permission to restore these pre-war differentials in pay, pointing out that because of longer hours or greater responsibility the foremen are earning less proportionately. You can also file for a foremen's incentive plan, and at the same time can apply for permission to put the foremen on a salary basis, and to give them longer vacations and sick leave with pay.

Complaint: "We are supposed to be apart from the rank and file, but we get no distinctions in treatment that make this apparent to the workers."

Solution: The foreman should have a visibly distinct status in the eyes of the labor force. Hence the value of separate (not necessarily better) facilities for foremen, including washrooms and locker rooms, separate or private parking space, etc. Free the foremen from punching a time-clock. Supply different badges, different-color pay envelopes. Encourage the foremen to keep together, and foster a team spirit and a foreman *esprit de corps.* Just as in the army, industrial "non-com clubs" have a distinct morale value.

The evidence presented in this summary of the foreman situation in industry today is far from complete. But it is sufficient to show that foremen as a whole can do a great deal more toward cementing employer-employee relations and, second, that top management has plenty of room for improvement in its handling of the foremen themselves. If both segments of management will do their best to overcome the problem, the benefits will be visible and sure—and within short order.

The Libbey division of the Owens-Illinois plant, where before the war quality glassware was the order of the day, is now busy producing essential glass items for the war effort. Illustration shows the gaffer shaping the mouth of a newly designed bottle used in mould culture for penicillen.

FORMER EMPLOYEE OF MATHIESON ALKALI POSTHUMOUSLY AWARDED PURPLE HEART

Second Lieutenant W. W. Highberger, of the Chemical Warfare Service, U. S. Army, reported missing a year ago and now listed as lost in action, has been posthumously awarded the Order of the Purple Heart "for military merit and for wounds received in action."

Lieutenant Highberger had been on the staff of The Mathieson Alkali Works from 1932 until September 1942, when he received his commission in the U. S. Army.

INVENTIONS AND INVENTORS . . .

(*Continued from page* 169)

dling glass sheets in connection with the operations of labelling them, and restacking them with interleaving so that they are ready for packing. This is a division of an application on which patent 2,285,921 has already issued.

Frank W. Preston of Butler, Pa., received patent 2,342,218 for a method of forming panels of corrugated or crenelated structural glass sheet. This is done by passing a soft glass sheet borne by a table with crenelated top, under a roll having crimping ribs, which depress the sheet into the crenelations. The essence of the invention is the provision of control means which give the roll a predetermined variable speed relative to the movement of the table. Preston reports that it is the experience of the industry that if the roll speed is held constant the glass is marred and scuffed because of the different angular speeds of those portions of the corrugating roll engaging the glass.

Glass Wool and Fiber

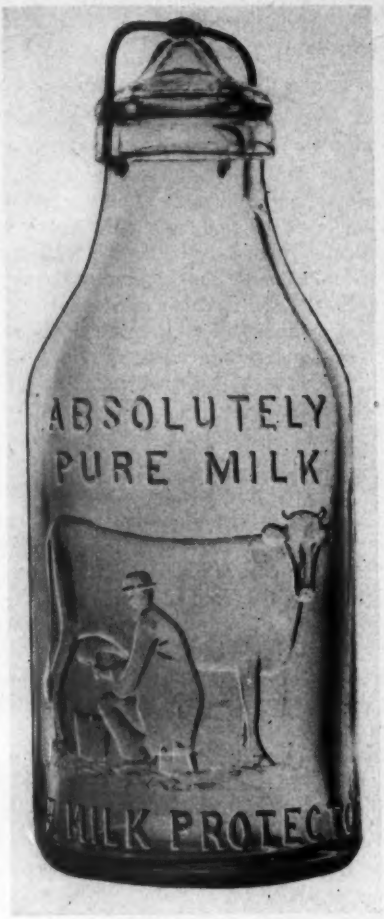
Harry N. Jones of Newark, Ohio, assigned to Owens-Corning Fiberglas Corp. his patent 2,341,219 for glass fibers coated with a semi-conducting film of carbon. He states that fibers so coated are desirable for insulating high voltage coils in motors and other electrical equipment. In accordance with the invention the carbonaceous material is applied as a solution of sugar, starch or other like substances, and the fiber is then heated partially to consume or pyrolize the coating.

PENSION PLAN FOR EMPLOYEES OF OWENS-CORNING FIBERGLAS

Owens-Corning Fiberglas Corporation has announced an employee pension plan and, contingent upon approval by the Bureau of Internal Revenue, workers who have been with the company at least twenty-seven years by the time they reach retirement age will receive during the remainder of their lives a monthly pension which, together with Social Security benefits, will equal 40 per cent of their average monthly earnings.

The company states that there will be no cost to employees whose basic earnings are less than $3,000 a year. Those whose basic earnings exceed this amount will pay a percentage of the cost. Time spent in the armed services will be taken into account in figuring retirement benefits.

Employees are eligible to participate in the trust fund after three years of service. Benefits are at the rate of one and a half per cent of the employee's average earnings, for each year of service, up to the maximum of 40 per cent, inclusive of Social Security benefits. Death and termination benefits prior to retirement are provided for.



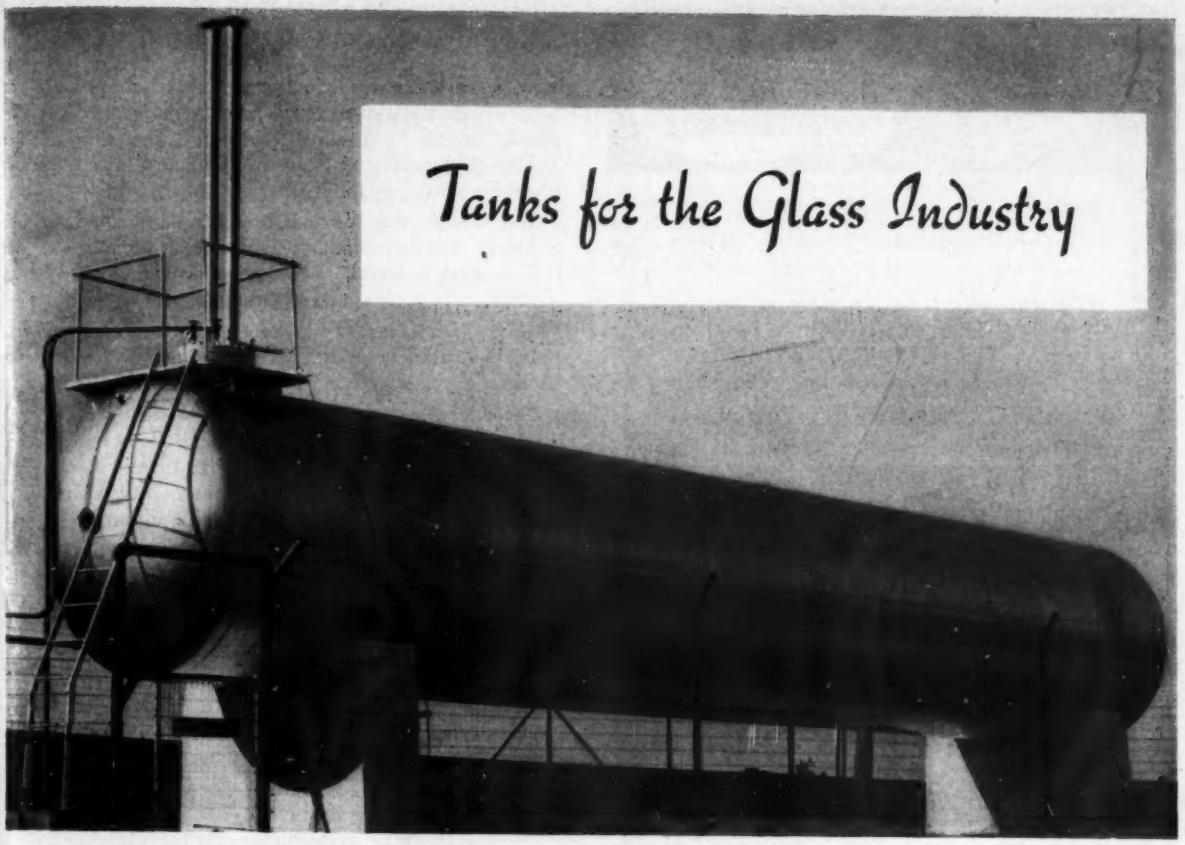
SIXTIETH ANNIVERSARY OF THE GLASS MILK BOTTLE

The Thatcher Manufacturing Company, Elmira, New York, has been manufacturing milk bottles for sixty years. In 1884 the first glass milk bottle was invented by Dr. Hervey D. Thatcher, an obscure doctor and town druggist living in Potsdam, New York. Up to that time milk had been carried in open cans in the milk wagon and transferred by dipper to the housewife's pitcher or jug—also open.

The first step toward the invention was the patenting of a lid for the milk cans, but this was not much better as dust and dirt blew into the milk each time the lid was removed along the route. Therefore, Dr. Thatcher continued to experiment and finally produced the first glass milk bottle—the original step in affording the consumer real protection all the way from the farm or dairy to the home.

As shown in the illustration, the original Thatcher bottle was designed with a glass stopper held in place by a bail, and just as is done today, the sides of the bottle were used for advertising purposes.

• The Armstrong Furnace Company, Columbus, Ohio, has purchased The Miller Foundry Company in that city. This company was established in 1923 by the late Edward Miller, former owner of the Miller Machine & Mould Works.



Tanks for the Glass Industry

● THE above illustration shows a propane gas storage tank 15,000 gallons propane—18,000 gallons water capacity 8' 0-1/16" I.D. x 50' 5¼" long working under a pressure of 200 pounds per square inch.

LANCASTER tanks, stacks and other products are custom designed and fabricated for your individual requirements. We are qualified to manufacture vessels in accordance with the A.S.M.E. Boiler Code, A.P.I.-A.S.M.E. Code and the various insurance company specifications.

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Elevated Tanks
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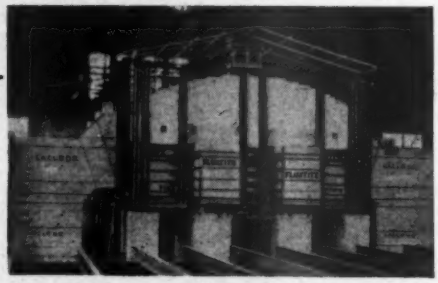

Complete Installations for Bottle Plants
Complete Installations for Window Glass
Complete Installations for Tableware Plants
Glass Melting Tanks and Furnaces
Refractory Materials—All Kinds and Shapes
Blocks—Fire Bricks—Prepared Pot Clay
Automatic Forming Machines
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Automatic Glass Tubing Machines
Lehrs-Annealing and Decorating
Installations Built to Suit Conditions Abroad

* * *

IF IT IS FOR THE GLASS INDUSTRY CONSULT US

General Glass Equipment Company

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GLASS TECHNOLOGY CLASS BEING GIVEN AT UNIVERSITY OF TOLEDO

Announcement was made last month of the course in Glass Technology currently being taught at the University of Toledo by Franz G. Schwalbe, Secretary of the Toledo Engineering Company. Further details are now given concerning the class.

The course was started last November and is an E.S.M.T. course—conducted in cooperation with the United States Office of Education, Federal Security Agency.

Glass Technology I was taught by Dr. Clarence L. Babcock of the Owens-Illinois Glass Company, and Glass Technology II is now being taught by Mr. Schwalbe.

The course covers a study of glass melting fuels and their combustion. The suitability and the economics of the various fuels will be considered from the standpoint of glass melting. A study of furnace heat losses and heat balances will be made to permit proportioning of the various component parts of a glass melting furnace.

Various types of glass melting furnace designs will also be considered, based on the type of glass that is to be melted and the tonnage required. Then, as the course progresses, the use of various refractories in glass melting furnace design will be considered.

Most of the students enrolled for this work are college graduates and all of them are actually engaged in some activity connected with glass manufacturing.

MECHANICAL PROPERTIES OF METALS AND ALLOYS

The current issue of *Technical News Bulletin*, publication of the National Bureau of Standards, carries a description of Circular C447, released a short time ago, summarizing the results of a comprehensive survey of the technical literature on the strength and related properties, thermal expansion, and thermal and electrical conductivities of ferrous and non-ferrous metals and alloys at normal, high, and low temperatures.

In general, the data are presented in tabular form, although graphical representation is often used to indicate the effects of changing composition or conditions on the properties. Data on aluminum, copper, iron and steel, lead, magnesium, nickel, tin, zinc, a number of miscellaneous metals, and their alloys are included. The Circular, which replaces C101 and supplement, is not limited to conventional engineering materials but contains data on the properties of many materials which are not usually classed as such. References to the sources of the data are included.

Copies of C447 are obtainable from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. The price is $1.50.

• The Association of Consulting Chemists and Chemical Engineers, Inc., announces the release of the revised and enlarged eighth edition of its Classified Directory, 1944. Copies of this book may be obtained free of charge by writing the Association at 50 East 41st Street, New York City.

GLASSHOUSE FRIGGERS . . .

(*Continued from page* 167)

was gathered around this core, and when this second gathering had hardened a little, it was pierced at three points by a sharpened stick or metal tool which had been dipped into the same murky water. Now, at equal intervals around the depressions thus formed, single drops of water were allowed to fall on to the surface of the glass, thus forming the silvery petals. More molten glass was now gathered on to the growing dump, and the process repeated until the final form was reached.

The two dumps just described were probably both made in Yorkshire, the flowered dump in the Conisborough district, and the bubble dump near Hull.

Within these lustrous crystal dumps,
Phantasmagorial gardens grow:
Exotic flowers of glass and air,
Imprisoned, bloom forever there;
Flowers that expand and shrink,
Enlarge again, and sink
Once more to normal size,
Before the watcher's eyes—
As, all around the glassy lumps
His charméd gaze moves to and fro.

TRAINING IN MILITARY NAVIGATION SPEEDED UP BY DEPTH PICTURES

Students in military navigation are now being trained by a new technique which teaches them more quickly than ever before to steer by the stars. The new technique eliminates the need for training students to interpret depth in flat charts and diagrams by presenting life-like pictures of models of the heavens and the earth in three dimensions. Professor John T. Rule, chairman of the Section of Graphics at the Massachusetts Institute of Technology, recently perfected the speedup technique which is made possible by Polaroid three-dimensional pictures known as vectographs.

The vectographs are prepared as slides for projection by standard projectors on a classroom screen and are so strikingly realistic that an instructor walking into the beam of a projected vectograph of the earth appears to be walking into the center of the earth.

WEAVER ELECTED VICE PRESIDENT AMERICAN WIRE FABRICS CORPORATION

The American Wire Fabrics Corporation, a subsidiary of the Wickwire Spencer Steel Company, has announced that Mr. B. L. Weaver was elected a Vice President at a recent meeting of the Board of Directors.

Mr. Weaver has long been associated with the steel industry and is considered one of the country's outstanding industrial engineers. In his new position with the American Wire Fabrics Corporation he will have direct charge of and the responsibility for all operations at the Mt. Wolf Plant, Mt. Wolf, Pennsylvania.

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BEVERAGE BOTTLE ROUND-UP

It appears that the success of the new return-bottle campaign depends, in the main, on the cooperation of the retailer with his customers in getting back the empties. This view was expressed by industrial leaders following the announcement of a nation-wide campaign to get some 500,000,000 empty deposit bottles out of hiding and into circulation.

While there have been isolated cases reported of store-keepers not wishing to take the bottles back, most of the reports show an increasing flow of bottles from store to home and back again.

The need for keeping deposit bottles in circulation has been intensified by the millions of glass containers sent to our fighters overseas. Those containers are used only once. Therefore, these bottles on the home-front should be taken care of and returned promptly as a war-conservation measure.

BATTELLE INSTITUTE APPOINTS NEW STAFF MEMBER

John B. Cahoon, Jr., a graduate of Ohio State University, has recently been appointed to the research staff of Battelle Institute, Columbus, and assigned to its division of ceramics.

Mr. Cahoon was formerly employed at the Engineering Experiment Station, Ohio State University. He is a member of the American Ceramic Society.

BOOK REVIEW

"Planning the Future of Your Business"

The Committee for Economic Development has just issued a handbook, "Planning the Future of Your Business," which was prepared for them by a special committee of the Association of Consulting Management Engineers. Given in detail, herein, are concrete steps which may be taken by industrial employers in planning for high postwar levels of production and employment.

The six steps in postwar planning by individual businesses as formulated in the handbook for industrial employers are: 1) Define and place responsibility for postwar planning; 2) Plan your product programs; 3) Plan your market and sales program; 4) Determine the manufacturing facilities you require; 5) Estimate your employment requirements, define jobs and plan employee training; and 6) Estimate the operating funds needed and plan their sources.

The handbook is obtainable only through the local Committees for Economic Development now organized in 1408 communities in all parts of the country. (It is *not* obtainable from the national C.E.D. office.) More than 48,000 industrial concerns, representing 73 per cent of the nation's 1939 factory output, are already working with local C.E.D. committees preparing check sheets of anticipated postwar employment based on realistic and close analysis of their postwar production plans and market opportunities.

GLASS RING JEWELS DEVELOPED BY GENERAL ELECTRIC

The glass ring jewels, developed by General Electric for certain of its aircraft instrument bearings, are now also available for many other applications. The jewels are listed in five sizes for use in precision measuring equipment, and other shapes and sizes are possible for such applications as thread guides, weighing scales, automobile and truck speedometers, and similar instruments and devices.

The glass ring jewels are an outgrowth of the work in developing glass vee jewels, introduced recently by the Company as the answer to the shortage of foreign-made sapphire bearings. The ring jewels, like the vee jewels, are superior to sapphire in many respects and are available at approximately 1/3 the cost. The ring jewels are supplied ready to set at $120 per 1000. They can be press-set or spun-set into bearing plates and other elements in the same manner as sapphire rings.

Surface of the hole in the glass ring is fire-polished in manufacture and is not touched subsequently. The flat surface opposite the "bell end" of the hole is highly polished by brushing with a suitable abrasive. This surface is also slightly chamfered at the edge of the hole and at the outside edge of the jewel. Outside diameter of the opposite flat surface of the jewel is also slightly chamfered to facilitate press setting and to avoid a fragile edge which might easily chip in transportation.

Dimensions are held to extremely fine tolerances; concentricity of the inside and outside diameters of the bearings is unusually accurate. The five sizes of bearings, listed include three outside diameters: 0.100 in., 0.0787 in., and 0.064 in. Rings have been made experimentally in sizes up to 0.5 in. outside diameter, and holes have been molded down to 0.005 in. diameter.

WESTINGHOUSE TO MAKE INSTANT-STARTING FLUORESCENT LAMPS

The Westinghouse Lamp Division, Bloomfield, New Jersey, has announced plans to manufacture an instant-starting 40-watt fluorescent lamp having the same rated life as the standard type of fluorescent lamp using conventional ballasts and starters.

This new lamp will eliminate the need for starters and will operate on a special type of instant-starting ballast.

GLASS INSPECTION
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Spectacle type polariscope

THE polarizing spectacle, mounted in unit with sensitive tint plate of 565 millimicrons, presents an absolutely uniform field of large aperture, strains showing up in sharply defined and correct colors.

Standard size apertures are 6" diameter and 12" diameter, and a rectangular size of 8" x 16"; but any special size to meet your requirement can be made. The 6" unit is suggested for either plant inspection uses or—as a portable unit for the trouble shooter or the salesman where a large aperture, compact unit of light weight is desirable.

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